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GENERAL VIEW OF THE DE LESSEPS MONUMENT.

THE BUST OF THE DE LESSEPS STATUE, BEFORE MOUNTING.

THE DE LESSEPS MONUMENT.

WE reproduce herewith, from L'Illustration, two engravings, the first of which gives a general view of the De Lesseps monument designed by the great sculptor Fremiet, and inaugurated at Port Said on November 17. The monument stands on a projection in the great jetty, at about 300 yards from the shore.

The second engraving, reproduced from a photograph taken during the mounting, gives all the details of the head, and permits of obtaining an idea of the dimensions of the effigy of the great man. The height of the head is 3·28 feet, and the nostrils measure about five inches.

ARTIFICIAL SILK.*

By JOSEPH CASH.

IT is a trite saying that all inventions are creatures of evolution. I shall give a short description, therefore, of a few attempts to produce the appearance of silk before the perfected artificial article of to-day became an established fact. Some were partially successful in effect and others have been a pronounced commercial success, adding greatly to the variety of the cheaper textile fabrics.

SPUN GLASS.

Spun glass is probably the earliest production which resembles natural silk. The thread is perfectly flexible, possessing great brilliancy, and is produced in a variety of colors. The feel to the touch is soft and smooth; it can be woven into many textiles, and is specially useful in millinery articles where warmth is not a necessary adjunct.

POLISHED OR DIAMOND COTTON.

Polished or diamond cotton is a lustrous looking article, and in the fine sizes, or counts as it is called in the trade, is silky in appearance and soft to the touch. An enormous trade is done in this article for dress goods, as it is often used in combination with silk. The process of producing it is very simple, waxy and starchy substances being put on the thread in a liquid emulsion; the yarn is then transferred to a polishing machine with rapid revolving brushes, which completes the process.

MERCERIZED COTTON.

A process for giving a silky appearance to cotton has lately been brought to the notice of manufacturers with very satisfactory results. The process is practised by most cotton dyers, there being no valid patent. The name is derived from the inventor, John Mercer, who discovered the process in 1844. The cotton yarn is passed through strong solutions of caustic lye. The yarn must be at full tension during the whole operation, even until it is quite dry. Mercer's theory of the action of caustic soda is that received to-day, viz., that the mercerized yarn is a hydrate of cellulose, the first action being the formation of a compound of sodium oxide and cellulose. The subsequent washing replaces the sodium oxide by water, which is held by the cellulose like the other metallic oxide. Such a theory as this gives us very little light on the matter, and does not explain the difference between the hydrate formed and the original hydrate. It can be dyed any color without materially affecting the brilliancy which has been imparted to it by the mercerizing process.

VANDURA SILK.

Vandura silk is a gelatine thread, therefore animal in its composition, and more nearly allied to natural silk than any of the imitations already described. Adam Millar, the inventor and patentee, quite recently died, unfortunately before he attained the perfection at which he was aiming. The manufacture of the silk is conducted by pressing an aqueous solution of gelatine through a very fine glass capillary tube. On issuing therefrom the thread is laid on an endless band which carries it some distance to allow it to dry; from the end of this band or table it is wound on to bobbins ready to put into skeins for the manufacturer. I am of the opinion that this article will not meet with a very great commercial success, as the gelatine being soluble in water, it cannot be dyed after the thread is made. Therefore the solution of gelatine must be colored to the required shade before being spun. The impracticability of this is manifest when I tell you there are at least fifty colors with fifty shades in each color, and at least four sizes of thread; the stock would be at least 990 pounds, if only one pound of each size and color was made.

Mr. Millar described his process as follows:

"I take 4 pounds weight of the best gelatine I can get, break it up into granular pieces such as will pass through a riddle of four meshes to an inch, sixteen meshes per square inch. I place the broken gelatine in a melting vessel, and add 2 pounds of cold water, and stir it well, put on a cover or lid and let it stand for one hour. The vessel is next placed in a can of hot water and kept heated to 120° F. for another hour, stirring it once or twice. By the end of the second hour I have a solution of gelatine of uniform consistency, containing 66 per cent. of gelatine and only 33 per cent. of water, a very thick solution.

"The group of filaments are next twisted together and spread out in a thin layer on an open metal reel, about a foot in diameter. A number of these reels of plain gelatine yarn are now placed in a chamber in which a very small quantity of formaldehyde has been poured, and is therefore filled with formalin vapor—about 80 minims of formalin to a space of 10 cubic feet. An exposure to this vapor at ordinary temperature completely changes the gelatine. It is no longer soluble, even in boiling water, nor in any solvent that I have tried, and has a splendid luster.

"The reels are hung up to allow all smell of the formalin to disappear, and the artificial silk is finished, needing only to be wound on to bobbins for the convenience of handling before it gets into the hands of the textile manufacturer.

"You will have noticed that this process for producing an artificial silk, which I have described, is a chemical process, but it is also a mechanical process. The successful substitute for the product of the silkworm must be a yarn made up of very fine filaments, so as to be smooth to the touch, and so pliable as to feel soft to the handling. The material of real silk, when obtained in somewhat thick threads, is neither smooth nor pliable, but is very harsh to the touch, and very stiff in handling. Indeed, to one not acquainted with the fact, it is very difficult to understand how the softest of velvets are produced from this harsh, stiff material—so stiff that it can hardly be tied into a knot. It is this extreme fineness of filament required in any artificial process which makes the mechanical part of the process such a dominating factor in the commercial aspect of the case.

"The nipples of my machine have a bore of one-hundredth of an inch, but the filaments drawn from these nipples may be only one-thousandth of an inch in diameter. The flow of the liquid through the nipples is regulated by air pressure. An India rubber pipe leads from a receiver of compressed air, and has its other end attached to a small pipe fixed to the airtight cover of the cylinder which contains the gelatin solution. The endless traveling band, on which the threads fall, and by which they are drawn away rapidly, moves at a uniform rate—say 60 yards per second; but if the speed be increased to 120 yards, the filament would be twice the fineness; the same result is obtained by reducing the pressure in the air receiver or reservoir."

COLLODION SILK.

Several persons have given their attention to the perfecting of the manufacture of collodion silk, among whom are Count Hilaire de Chardonnet, Dr. Lehner, and Nobel of cordite fame. The different systems vary only in detail, so I shall describe the most successful one, known as the Chardonnet silk. I first saw this artificial silk at the Paris Exhibition of 1889, where it obtained a "Grand Prix." Previous exhibits were made of artificial silk in 1878, but no commercial success was attained for many years.

A public company for the manufacture of artificial silk by the Chardonnet process has been formed in England. The factory, extending over two acres, is at Wolston, on the river Avon, near Coventry, and will be capable when filled with machinery of producing 7,000 pounds of silk per week.

The first stage of manufacture is the nitration of cotton or wood pulp, producing pyroxyline, discovered by Pelouze in 1838. The greatest care must be employed in conducting this operation, as it is the most important one in the whole process; mistakes sometimes even occur at the long established factory at Besançon in France. The process of nitration of cellulose is the displacement of a few molecules of hydrogen by nitric peroxide. There are several varieties of pyroxyline which are obtained by using different mixtures of acid. The highest nitro-cotton product, gun cotton, or trinitrocellulose, is useless for the manufacture of artificial silk, as it is insoluble in a mixture of alcohol and ether. To obtain the pyroxyline or binitrocellulose suitable for the production of collodion for our purpose, a mixture of 15 volumes of sulphuric (H_2SO_4) and 12 volumes of nitric acid (HNO_3) is made; two pounds of bleached raw cotton is then taken and put into an earthenware jar with about three gallons of mixed acid; this is left standing for four to five hours, when the nitration is complete. The chemical reaction may be expressed by the following formulæ:

$$C_6H_{10}O_5 + 2HNO_3 + H_2SO_4 =$$
$$C_6H_8\,2(NO_3)\,O_5 + 2H_2O + H_2SO_4.$$

The object of the sulphuric acid (H_2SO_4) is to take up hygroscopically the excess of water produced, leaving the nitric acid (HNO_3), of which there is always an excess. The only known way of testing the quality of the pyroxyline is the use of the microscope in conjunction with the polariscope. A small piece of pyroxyline is taken from one of the jars, thoroughly washed in water and dried; it is then moistened with alcohol, when the colors exhibited should be in exact proportion which practice has proved to give the best results.

The pyroxyline is now taken out of the pots and subjected to pressure to extract all the acid possible. This extracted acid is not wasted, but is renovated with a mixture of new acid and used again for more cotton. From the press the pyroxyline is taken to the washing room and at once put into the washing machine, called a Hollander, and similar to those used in paper making for washing pulp.

This washing continues for from 12 to 15 hours until the acid is thoroughly eliminated; from thence the material is removed to a centrifugal machine to extract the moisture, which must not exceed 28 per cent.; if too much water is present, the collodion will not be tenacious and therefore will not spin. The pyroxyline is now ready for dissolving in a mixture of alcohol and ether. The pyroxyline is placed in a cylinder, with a mixture of 40 parts alcohol and 60 parts ether; the cylinder is then hermetically sealed and made to revolve slowly for 12 hours, when, if the pyroxyline is good, all should be dissolved; the resulting mixture is collodion. The next process is the filtration. Upon this depends the amount of production from the spinning machinery, supposing the collodion be good. The filtering is to eliminate every particle of suspended matter which may exist in the collodion before it arrives at the spinning machines, as grit and seeds from the cotton, or suspended matter in the washing water, or even trinitro-cellulose, which is insoluble in alcohol and ether, but this latter should never occur in good silk collodion. Each filter contains a sheet of cotton wool between calico. A pressure of 15 atmospheres is required to force the collodion through the filters; it is therefore first passed into an hydraulic press, by the aid of which it is forced through the filters and into the collodion reservoir, where it should remain as long as possible to allow any bubbles to rise to the top, for should they pass into the glass silkworms, the continuity of the thread would be broken.

A pressure of 40 to 45 atmospheres is required to force the collodion from these reservoirs to the spinning machines, which are constructed with pipes running on each side. Into these pipes are screwed a number of taps with a glass capillary tube fixed on the end, called a silk worm, through which the collodion is forced by the pressure before mentioned; immediately it comes into contact with the air it solidifies, enabling the operative to take hold of the thread or silk, as it can now be called, and convey it to the bobbin. From twelve to twenty-four of these threads are run together on to one bobbin, according to the size of silk required, as is the case with natural silk. The silk would soon dry by the evaporation of the alcohol and ether if left exposed to the air; it is therefore kept moist by damp cloths to facilitate the next process of throwing and twisting. This is accompanied by putting on the silk the required number of turns or twists per inch. The reeling or skeining of the silk into a given number of yards in each skein is the next operation. One thousand or two thousand yards is the usual quantity, and according to the weight of skein so is the size designated. The Chardonnet silk is about 30 per cent. heavier in S.G. than natural silk, so the comparison of sizes is easily arrived at. The silk is still damp, and should now have the remaining alcohol and ether dried out of it. The inventor claims this to be one of the most important points to give the silk good dyeing properties.

The silk at this point of manufacture is very inflammable and quite unfit for use in textile goods, therefore a process called denitration is next carried out which reconverts our product into cellulose, now very different in appearance from the raw cotton we commenced with, but practically the same in chemical composition.

One of the substances used for this purpose is sulphydrate of calcium, and the chemical reaction may be expressed by the following formulæ:

$$C_6H_8(NO_2)_2O_5 + 2\,Ca\,H_2S_2 =$$
$$C_6H_{10}O_5 + 2\,Ca\,NO_3 + H_2S + S_2.$$

The silk, now it is finished, requires no precautions in manufacturing more than cotton, in fact less, as there should be no loose fiber which can detach itself from the thread.

The bleaching is carried out in the usual way for vegetable fibers with chloride of lime and acid.

Up to the present time artificial silk has always been used in conjunction with other fibers in textile goods; the friction of weaving has a tendency to split the threads if used in warps, but this objection will no doubt be overcome.

Mantles for the incandescent gas light are manufactured of artificial silk, it being found that the salts of the rare metals can be mixed with the collodion with greater economy than with any other thread.

For braids and such classes of trimmings it is much more brilliant; for covering electric wires and all electric work it is better. Large works are in operation at Besançon, in France, producing 7,000 pounds per week; but the demand is so great that they are making extensions to their works to enable them next January to produce 2,000 pounds per day. The production at Sprietenbach is 600 pounds daily. Other factories are about to be established in Belgium and Germany.

Collodion silk can never replace natural silk in articles where warmth is required, its composition being vegetable, and that of silk analogous to horn and hair or wool. The artificial product is to be preferred, being more durable than the natural when the latter is weighted in the dyeing up to 100 per cent. in colors, and as high as 300 per cent. in black. If this system of weighting natural silk for manufacturing dress goods continues, I am of opinion ladies will be asking for dresses of the new product in preference to the old, unless a guarantee is given that the article is pure natural silk.

* Paper read before the Society of Arts and published in the Journal of the Society.

THE HISTORY AND PRESENT DEVELOPMENT OF WIRELESS TELEGRAPHY.*

By GREENLEAF W. PICKARD, Boston, Mass.

I MUST in the start limit the meaning of the phrase "Wireless Telegraphy." It is evident that, strictly speaking, communication with flags and numberless other methods would properly come under this head. I intend to take the phrase in its popular significance and consider only the purely electrical methods of signaling through space.

Wireless telegraphy has a history—a history that runs much further back than most people imagine. The idea of magnetically communicating through space between distant points is over two centuries old, and electrical means of accomplishing the same end were thought of before the beginning of the present century. The first successful attempt at space telegraphy was made sixty-eight years ago by a Scotchman. In 1831, James Bowman Lindsay, of Dundee, Scotland, conceived the idea of conveying electrical signals across water without the use of wires, and actually so did convey them across the Tay River. He even went so far as to express the opinion that signals might be transmitted across the Atlantic, and in the printed proceedings of the British Association for 1859 his method is briefly described. More recently Prof. Silvanus Thompson has suggested the same method, and there is no doubt in the minds of electricians but that it would work across the Atlantic Ocean. (A diagram was shown illustrating Lindsay's system.) On one side of the pond two metal plates dip into the water as far apart as possible. In circuit with these plates are a battery and key. When the key is pressed, a current flows in the circuit, passing through the water between the plates, and seeking the path of least resistance. In so doing, the current spreads out, a very small portion of it going to the other side of the pond, where it is picked up by two other metal plates there and passed through a sensitive telephone receiver, manifesting its presence by a click.

Electrical phenomena often have very apt hydraulic analogies. If instead of having a current of electricity lead into the pond at one plate and out at the other, we had a current of water, it is evident that the stream would spread out and flow sluggishly through the entire pond, and that a delicately poised waterwheel would show this current even in a distant portion of the pond. Only one such transmission of signals could be operated at a time, because a system powerful enough to send messages from England to America would interfere with the working of every similar system in Europe, in addition to rendering all of the transatlantic cables worthless, by its powerful current scattered broadcast in the water.

A system of space telegraphy based on electromagnetic induction has been tried both in this country and abroad with success over short distances. Preece, the chief electrician of the British postal service, has de-

* Paper read at the thirty-fifth stated meeting of the Maine Academy of Medicine and Science, November 13, 1899, and published in Journal of Medicine and Science.

voted much time to experiment with this system and sent messages several miles by its aid. It was in practical operation in England a few years ago between a lighthouse and the shore, where strong tides and a shifting bottom would not permit of the maintenance of a submarine cable. This lighthouse was on a small island over a mile from shore, and a wire was strung from one end to the other parallel to the mainland. At a point on the shore opposite the lighthouse, a long wire was placed parallel with the first and connected with a key and a small dynamo, so that powerful currents could be passed for signaling. The induced current in the lighthouse wire, although not strong enough to operate a telegraph instrument, could be plainly heard in a telephone receiver, and the dots and dashes of the Morse alphabet easily read. (This system was illustrated by diagram.) When the key is pressed, a current flows in the sending circuit, inducing a momentary one in the reverse direction in the receiving circuit, and the telephone that is connected there will respond. Experiments made with this system show that for clearness of the signals in the receiver, the lengths of the parallel wires must be equal to the distance signaled over, that is to say, the distance between the nearest sides of the rectangles in the diagram. This requirement is of course a great drawback to its employment over any considerable distance. Every one who has used a telephone has noticed what is called "cross talk," which is nothing more or less than induction from neighboring lines, and is a good example of the practical operation of the electromagnetic induction system of wireless telegraphy in an undesirable manner. Perhaps in this case a better name for it would be that of "wireless telephone."

In 1882, Prof. Dolbear, of Tufts College, well known in connection with the invention of the telephone, experimented with a system very much like the present one of Marconi's, using long vertical wires at both stations, and an induction coil for sending the signals, connected as in the last method, one terminal to the wire and the other to the ground. Instead of receiving them by a device known as a coherer, as Marconi does, Dolbear used a static telephone receiver to detect the signals. Using kites coated with tinfoil, at an altitude of several hundred feet, he was able to detect the signals at a distance of over a mile. A patent for this method of communication was asked for in the same year, but was then refused by the Patent Office, as being "contrary to science;" and it was only after the apparatus had been packed up and sent to Washington, and the fact demonstrated that it would work, whether "contrary to science" or not, that the patent was granted in 1886. An important feature of this patent is, that although a telephone receiver was employed to detect the waves, a paragraph of the patent states explicitly that "any other receiving device may be used," which of course covers Marconi's apparatus, or that of any other system employing a vertical wire and a ground.

A very practical system of wireless telegraphy from moving trains was patented by Phelps in 1886, in which the signals were transmitted from a wire strung on the poles alongside the track, one of the ordinary telegraph wires, in fact. They were received by the tin roof of the car, to which one terminal of a telephone receiver was connected, the other terminal being grounded on the wheels below, which of course made contact with the rails. The sending station was in any convenient way station of the railroad, and for the transmission of the signals a powerful induction coil was used, one of the secondary terminals being grounded while the other was connected to the wire. By making and breaking the primary circuit of the coil, the dots and dashes of the Morse code could be sent into the wire, a dot consisting of a single spark and a dash of a series of sparks following one another at very short intervals. The telephone on the car would receive these as short and long buzzing sounds, that an experienced operator could easily read. There was also an induction coil on the car, so that the reply could be sent to a messenger. This system was in successful operation on several railroads, among them being the New York, New Haven and Hartford, but it was finally abandoned, as there was not enough business to pay the expenses of an operator on the train.

I have drawn an analogy between the first mentioned system and a flowing stream of water. Now the systems of electromagnetic and electrostatic induction do not depend upon an actual flow of electricity between the stations, but rather upon a wave or impulse in the ether. The best analogy here would not be an hydraulic one, but with sound waves. Sound is not transmitted by an actual bodily movement of the air, but by an impulse transmitted from particle to particle, each particle simply oscillating to and fro. Ether waves travel in a similar manner, but very nearly a million times as fast as sound is propagated.

In 1888, Hertz, a German physicist, demonstrated for the first time the existence of electrical waves in the ether, waves that possessed all the properties of visible light as regards reflection, refraction, and diffraction, but that on account of their great wave length as compared to that of visible light, could penetrate wooden walls with ease. The longest ether wave that is perceptible to the eye has a length of three hundred-thousandths of an inch, while the shortest Hertzian wave yet produced has a wave length of over three-tenths of an inch. (A diagram was shown of the apparatus used by Hertz for exciting and for receiving these electrical waves.) The oscillator is composed of two metal plates connected to a spark gap between polished brass spheres and to an induction coil. The induction coil, fed by a battery, charges the metal plates oppositely until the electrical tension between the spheres of the spark gap becomes so great that the air between them breaks down and a spark passes. This spark, although to the eye a single one, in reality consists of a number of extremely rapid surgings of the electrical charge on the plates, first in one way and then in the other. There may be a score of such oscillations before the charges have neutralized each other and equilibrium is established, all taking place within less than a hundred thousandth part of a second. The oscillation is like that of a pendulum, set swinging by the hand, that goes past its lowest point, the point of equilibrium, again and again before it comes to rest in this position.

The oscillation of the electric charge on the plates sets up a disturbance in the ether, a disturbance that propagates itself as a series of waves, traveling with the speed of light in all directions from the oscillator. Like light the intensity at a point distant from the oscillator is inversely proportional to the square of the distance. The detecter devised by Hertz to show the presence of these waves consists of a circle of stout wire, with a very minute spark gap inserted. When the oscillations strike the wire, their energy is transformed into an electrical current, that manifests itself as an almost microscopic spark at the gap. A detecter such as this is not a sensitive one, and Hertz at the best could trace the waves but two hundred feet from the oscillator. It remained for Lodge, an English physicist, to discover an extremely sensitive detecter of electrical waves, an instrument called by him the "radio-conductor." This consists of a glass tube, partly filled with metal filings, and with electrodes inserted at each end. The electrical resistance of such a tube is normally very high, so high that it presents an almost insurmountable obstacle to the passage of an electrical current, but when the electrical waves strike it the resistance falls, the metal filings begin to conduct—to "cohere," as it is called—and the current thus established will allow a telegraph relay to operate over it. Such a tube of filings is called a coherer.

Marconi, the young Italian experimenter with the new telegraphy, commenced his experiments in 1895, adopting the oscillator of Hertz, and the coherer of Lodge. He very soon found that the addition of a long vertical wire to a terminal of both the oscillator and the coherer tube, the other terminals being grounded, very greatly increased the efficiency of the system, and that the distance that could be signaled over was increased in a more than arithmetical ratio to the length of this vertical wire.

I have set up a sending and a receiving station in this room. Both the receiver and transmitter are connected to short vertical wires, and for a ground I have used the wooden floor. A pressure on the key at the sending station sends a current from the storage battery through the coil, from whose terminals it emerges greatly increased in tension, and charges the vertical wire, which discharges itself across the gap to earth, setting up a powerful impulse in the ether that radiates in all directions from the wire, an almost infinitesimal portion of it reaching the distant wire and the coherer tube. Here the filings in the tube instantly cohere in response to the wave, and become a conducting path for the current of the local battery operating the relay. A point to which I would call special attention, is the extreme sensitiveness of the coherer. The most delicate of the measuring instruments known to science would not respond to a million times the energy that this device detects and instantly responds to by a lowering of its electrical resistance. One way of illustrating this sensitiveness would be to consider the case of signaling across the English Channel, a distance of about thirty-four miles. We may consider the energy from the sending station as radiating outward in the form of an ever widening sphere. When the wave had reached the distant station, this imaginary sphere would have a radius of thirty-four miles, or about one hundred and eighty thousand feet. The entire surface of this sphere would be over 400,000,000,000 square feet; and if the vertical wire at the receiving station presented an area of one square foot to the radiation, it would intercept only the infinitesimally small portion of one 400,000,000,000th of the energy, assuming that there had been no absorption in transmission. When we consider that the wire at the sending station probably emits less than a hundredth of a horse power in electrical waves, the smallness of the fraction that reaches the other end is apparent. Even the bolometer of Langley, an instrument that will detect the radiant heat of a candle at two miles, is clumsy in comparison with this simple tube of filings.

Early in the past summer the Smithsonian Institution, hearing of Marconi's successful experiments with long distance wireless telegraphy, desired that experiments be tried at the Blue Hill Observatory, near Boston, with kites to elevate the wires, hoping that as an altitude of over two miles could be attained in this way, correspondingly great distances could be signaled over. A grant was made from the Hodgkins fund for the work, and Mr. Rotch, director of the observatory, asked me to assist in the experiments. We commenced our work in June, at the Blue Hill Observatory, situated in Milton, about ten miles from Boston. Our first trial of a somewhat crude apparatus between the observatory at the summit and Mr. Rotch's house at the base of the hill gave us such encouraging results that this distance, a little over a mile, was increased to three, the summit of Mount Chickatawbut, one of the neighboring hills, being taken as the other station. In our first trials, between the summit and the base, kites were not used, as the flagpole on the observatory and a small tower near the house at the base gave us a support of sufficient height for our wires. We tried the kites for the first time between Blue Hill and Chickatawbut, sending up a light copper wire, about five hundred feet in length at the receiving station, and a shorter though heavier one at the sending station on Blue Hill.

Our troubles really commenced when we moved to Chickatawbut. Day after day we would make the long journey to the summit, and find on reaching the top that there was no wind to raise our kite. Or else, as frequently happened, there would be just enough wind to support the kite, and not the additional weight of the copper wire and flying cord, and an entire forenoon would be spent in the vain endeavor to raise the apparatus, usually ending in the fall of the kite, cord and wire in the bushes on the side of the hill, the wire always becoming most completely tangled up with the bushes, kite and cord. During the entire period that we were at Chickatawbut, over a month in all, there were but four days that favored us in this respect. Unfortunately for our experiments, we had taken a time of year when there was very little wind, less than usual for that time of year even. The first day that we succeeded in raising our kites at both stations signals were sent and received, but a not altogether unexpected difficulty arose—that of the interference of the atmospheric electricity with signaling. Our long wire collected enough electricity to give frequent signals—frequent enough to greatly complex those sent from Blue Hill. These interruptions showed clearly that the limiting height of the conductor was under five hundred feet, and that the wires of a mile or more in length that the Smithsonian had thought of would gather so much electricity as to completely disorganize the delicate receiving apparatus.

I must here explain something of the nature of this atmospheric electricity. As far back as the days of Franklin it was known that the atmosphere was in an electrified condition, and that a sufficiently long upright conductor would show marked signs of electrification, and even sparks between it and ground, on clear as well as cloudy days. Later and more accurate measurement showed that this electrification increased in proportion to the altitude, and that it was always present, although in varying amount, and that it bore certain relations to meteorological conditions. Some of our experiments have shown that in addition to this change from day to day, there is a momentary variation in the current down a long upright conductor, a variation from second to second, precisely as if the upper end of the wire were being struck by a series of lightning strokes in miniature. It can readily be imagined how troublesome such interruptions must be, and what a disturbing effect they have upon the even tenor of a telegraphic message. We soon found that the best results, as far as freedom from such disturbances was concerned, were obtained when the wires did not exceed two hundred feet in length. Even with comparatively short lengths of wire, from thirty to forty feet, a delicate adjustment of the coherer and relay would show the presence of atmospheric electricity by occasional clicks. One of my experiments seemed to show a definite relation between the wind velocity and the frequency of these clicks.

After a satisfactory conclusion of the experiments at Chickatawbut, a greater distance was tried—that from Blue Hill to Memorial Hall, Cambridge, about twelve miles. Instead of using kites at both stations this time, the tower of Memorial Hall was used as a support for the wire, and a kite flown at Blue Hill when we wished to signal. Again we had to wait for a favorable wind, and after an interval of nearly a week were enabled to make our first trial. This trial was partially successful, as most, if not all, of the signals sent were received, although not all identified. But a new difficulty arose, that of interference from neighboring electrical apparatus, particularly the electric cars, which run quite near the hall. Every time that an electric car approached within a hundred yards of the apparatus, it was heralded by a series of dots and dashes—an incoherent message sent by the changing current in the motors of the approaching cars. It was apparent that we had all the essentials for a very perfect form of car indicator, but a car indicator was not at all desirable; for we wished to receive the signals from Blue Hill intact, and not overlaid with a bewildering tangle of electric car messages.

I am at present engaged in a series of experiments in wireless telegraphy for the newly organized company—the Wireless Telephone and Telegraph Company—at Providence, R. I., between two experimental stations there, which are placed among the worst possible conditions for such work. Although the distance there is small—under two miles—there is an intervening hill, numberless wires in the immediate neighborhood of both stations, and electric cars galore, some half dozen lines between our stations. We have had little trouble with this plant, as it has worked perfectly from the start, and by a few changes of detail we have been enabled to transmit messages at the same speed as that of an ordinary telegraph line, that is to say, about thirty to forty words to the minute.

As yet the commercial future of wireless telegraphy is not well defined. There is, of course, a wide field at once open to it as a means of communication between ships, between lighthouses, lightships, and the shore, and especially as a danger signal in stormy weather and in fogs. Its service to the navigation of the future will be of the greatest importance. The service that it can render in this direction is apparent when one looks over a list of the vessels and lives that are lost for lack of such certain communication. One of the strongest points of this system is its cheapness and great compactness. Probably the cost of Marconi's installation for signaling across the Channel was not in excess of a thousand dollars. This will enable it to economically replace short submarine cables, where the traffic is insufficient to carry the expense of a submarine cable. Submarine cables are expensive things, costing about as much a mile as a complete installation for wireless telegraphy. As an aid to naval operations it has already been of service abroad, its compactness and ready installation on board of any vessel being points in its favor.

For certain purposes it may be used between disconnected points on land, particularly in military operations, where immediate communication is desired between forces miles apart, and there is no time to erect a military telegraph line. It is also apparent that such a "line" of communication cannot be cut by the enemy, although if they were equipped with the proper receiving apparatus they could receive the messages, and profit by them. Sending in a cipher code would of course render such messages valueless to the enemy, or better still some system of electrically tuning the instruments that I shall speak of presently.

But before this system can come into successful commercial use, there are difficulties that must be overcome, and very serious difficulties many of them are.

As I have before stated, the waves are not in any way directed, and a receiver placed anywhere within the range of the transmitter would pick up the message. Leaving out of consideration the rapid diminution of energy with increased distance, this is both an advantage and a disadvantage of the system. It is an advantage if a lighthouse is signaling a ship in the fog, whose position is unknown. It is a disadvantage inasmuch as anyone with a receiving instrument can pick up the message anywhere within the range of the transmitter. In addition to this the present system is not an electrically tuned one, that is to say, that any receiver will respond to any transmitter, and there can be but one transmission going on at a time within the radius of the influence of the sending station.

The possibility of electrically tuning a receiver to a distant transmitter, so that it will respond to this and to no other, is an interesting one, and I think that a little explanation will not be amiss. I have before spoken of the varying lengths of the waves, these lengths being chiefly dependent on the linear dimensions of the transmitter. It is well known that if two

tuning forks are of the same pitch, if one be set vibrating, the other will respond even though it is at a distance from the first, and (excluding from the discussion the effect of a fork an exact octave above or below, or even of an interval of a fifth) it will not respond to a fork of a different pitch. It is evident that if we had a series of tuning forks, of varying pitches, at one end of a room, and an exactly similar series at the other end, we could send a number of signals simultaneously, and without interference, each fork responding to its mate and no other. In a like manner we can imagine a number of wireless telegraph systems working side by side without interference. Unfortunately, there are at present no receivers sensitive enough for long distance work that will respond only to one wave length. The combination of coherer tube and vertical wire will respond equally well over a vast range of wave lengths, from the short ones set up by a small oscillator to the long ones that are caused by changing currents in the electric car motor. What the future will bring forth in the way of electrically tuned receivers is impossible to predict, and one can only say that this line of investigation is a most promising one.

I have mentioned the fact that electrical waves are capable of reflection, as are those of light. An oscillator placed at the focus of a parabolic mirror will send forth a parallel beam of Hertzian waves, that can be as accurately directed as the rays from a searchlight, and unless a receiver is in direct line with this beam it will not respond.

At present, there is no way of producing sufficiently intense Hertzian waves from a small radiant point. Unless the waves proceed from a very small surface, one that is practically a point, the mirror cannot send them out in a parallel beam. However, such a system, using parabolic mirrors at both stations, has been tried over a distance of two miles with success, the rays being so nearly parallel that at this distance from the mirror, the width of the beam was found to be only fifty feet, the receiver working vigorously in this space and not at all outside of it.

BLOCKING OUT SKIES.

MANY negatives have what are known as "dirty skies"—that is, the sky of the negative is thin in parts, thus making a muddy or tinted sky in the print. If clouds are required on the print, the sky, of course, must be perfectly white, otherwise they would print in flatly. There are two methods of blocking the skies out on the negatives—painting out and pasting out. The former is the one usually resorted to, and is done as follows: Obtain a tube of ivory black oil paint, a small sable, and a hog's hair brush, also some turpentine. Squeeze a little of the paint out, and carefully paint round the edge of the sky against the horizon. Care must be taken that the color does not overlap any part of the view. Next use the hog's hair brush, and paint all over the rest of the sky. Every bit must be covered, or it will print patchy. The sky must look perfectly opaque when viewed by transmitted light. The only disadvantage to this method is that the paint takes several days drying. The other method is to do an untoned print of the negative, place on a glass film, side up, and with a sharp penknife carefully cut away the view, leaving the sky intact. Then smear some thin paste all over it, and place on the sky of negative, to register exactly. If carefully done, the sky will print perfectly white.—"O. T.," in Photographic News.

THE HOMEMADE WINDMILLS OF NEBRASKA.

By ERWIN HINCKLEY BARBOUR.*

WHILE engaged upon the preparation of a paper treating of the relations of the homemade windmills of Nebraska to its agriculture, the writer finds such great and increasing demand for some short and immediate report on the subject that he is led at the request of correspondents to publish the following brief preliminary paper, awaiting the time when a systematic and formal report may be possible.

It is not the writer's object or intention to offer our citizens advice—for he is the one who is under instruction—but rather to bring together views of a number of mills and to compile facts about their uses, construction, cost, and durability, which may be of possible use to prospective builders, and by which they may be enabled to select the design which seems to them least faulty or best suited to their individual wants.

FIG 1.—The Baby Jumbo, designed and built by W. W. Iler, Havelock, Nebraska. It has four fans each 3 feet long, with arms 2½ feet long attached to an iron axle. It is attached by a 16-inch crank directly to the pump handle. It is mounted on a 16-foot tower. This little mill, which cost but $1.70, pumps water for the stock and for a boarding house with thirty guests, lifting the water from a 60-foot well.

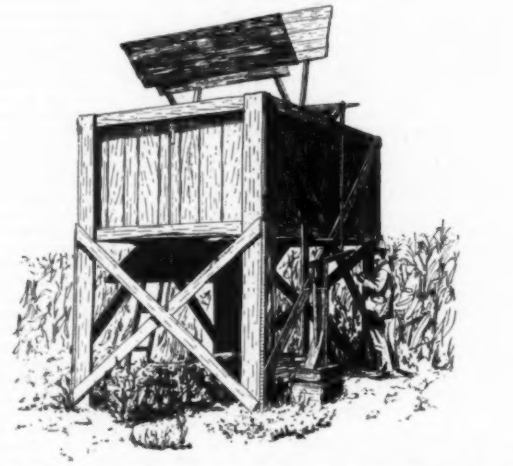


FIG. 3.—A six-fan Jumbo windmill on the farm of W. W Goodrich, Bethany, Nebraska, used in watering a 6-acre patch of egg plants for the Lincoln market. The fans are each 9 feet long, with arms 5½ feet long. Jumbo box 9×11×6 feet high, with door below for the escape of dead air. Extra well built. Axis of Damascus steel. Total cost, $8.

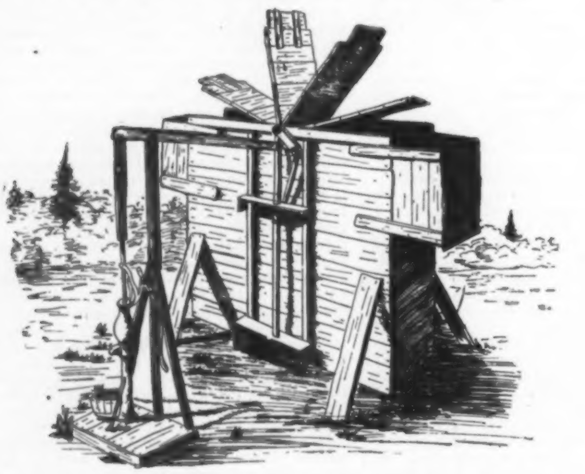


FIG. 2.—A remarkable little Jumbo, designed and built by Mr. J. L. Brown, proprietor of the Midway Nurseries, at Kearney, Nebraska. It cost but $1.50, yet it pumped sufficient water to irrigate and save the garden truck, the strawberry patch, and the small fruit during the most trying season of drouth ever recorded in the State. Box 3 feet wide, 9 feet long, 6 feet high. Eight fans 3 feet wide by 4½ feet long, supported on a gas pipe axle.

FIG. 4.—Mill No. 1 of the Travis brothers, market gardeners, Lincoln, Nebraska, showing edge of reservor, 150 feet long, 4 feet wide, 2½ feet deep. The sails are made of old coffee sacks. The "cut-offs," or wind guards, may be seen on either side. These are raised and lowered by pulley and rope. Dimensions, 9 feet wide, 18 feet long, 18 feet nigh. Cost, $8. Successfully irrigates a 5-acre garden.

In the judgment of the writer, whose seven years of residence has enabled him to visit nearly every corner of Nebraska, this is an important agricultural movement, and is worthy of much fuller treatment than is possible within the scope of this paper.

The importance of this movement, inaugurated by the inventive farmers of Nebraska, is made manifest in that many acres of garden truck, fruit land, and even farm land are irrigated; that stock is supplied with water; that ranchmen and sheep herders are benefited; that dairy products are increased and improved; and that the comfort of the village and the rural home is often enhanced.

The merit of homemade mills has enjoyed such prompt recognition that they are going up daily. Not to the detriment, we are happy to say, of those important adjuncts to the farm, the shopmade mills, but in addition to them.

In a given community, the man who puts up the first mill generally furnishes the model for the rest of the community. Hence it seems the more desirable that good models should be at hand. The better models are often of quite as easy construction and no more expensive than the poorer, and their efficiency considerably greater. It is advantageous to have good models to copy, and the next best thing to the actual model is a good simple drawing. This is the first object of this paper on our homemade windmills; it aims to supply cuts illustrating all sorts of windmills as found in Nebraska. These in a certain way will serve as models and may guide citizens to this extent, that they may benefit by the experiences of others without necessarily compromising their own individuality and personality. They can build the mill which they have conceived of, and do it in their own way, and yet they may benefit somewhat by what others have done before in the same line.

Those who have had little chance to observe for themselves can scarcely be brought to realize the great number of homemade mills and the wide territory which they cover. But to the writer's knowledge they extend in almost unbroken succession from Omaha to Denver, and from South Dakota through Nebraska, Kansas, and Oklahoma, our own State being plainly the center of the movement. The writer has gone by rail over the various roads; has driven by team; has employed—at his own expense—students to drive several times across the State in various directions. In this way, as will be very plainly seen, a large number of places have been visited and a very fair survey of the windmill has been made, and from the knowledge obtained it may be said that the Platte valley from Omaha to Denver seems to be the very backbone of the homemade mill, its ribs extending out on all sides along the lesser river courses of the State. They are found in valleys rather than on table lands, for the reason, perhaps, that there the water is shallower and more easily raised by mills of low efficiency.

As said before, the first mill sets the style in mills for a community. Accordingly, in certain German settlements we find the old fashioned Holland mills, more or less modified, until they little resemble the original or mother mill.

As to the usefulness, cheapness, and durability of such home-made productions, it may be said that a good basis for a fair judgment in this matter is found in the fact that the designers and projectors speak in high praise of their mills. This would be otherwise if the mills were not satisfactory in each of the above respects. Some are so hearty in their praise of the homemade mill that the author by contact comes naturally to speak with equal confidence of these mills as important agricultural aids. Some have looked upon them with distrust, believing that any citizens too poor to put up the regular shopmade mill were on the face of it shiftless, unreliable, and undesirable citizens. As a fact it turns out that just the reverse of this holds true.

The builders of homemade mills in Nebraska are generally the wealthier and more progressive among the older and better established farmers; or else

* Condensed from the Bulletin No. 59 of the United States Agricultural Experiment Station of Nebraska, Lincoln, Neb., to which we are indebted for kindly lending the engravings.

younger men, just making a start, but with good credit and as fair promise as their older brothers; or else market gardeners, ranchmen, cattlemen, sheep herders, or others.

This much is certain, that they are put up by our best citizens, and not by the worst, and by a stable, and not by a roving, unsettled, or shiftless class.

While some beginners use the homemade mill for irrigation of the garden and for supplying the house, others make luxuries of them rather than necessities in this sense, that they put them to work in various ways to save hand labor, such as running the grindstone, the churn, the feed grinder, corn sheller, the wood saw, and other farm machinery.

As to the cost of such mills it may be stated in a general way that they are inexpensive, and that their cost is not as great as their usefulness. In dollars and cents the average mill will not fall far from four to five dollars, not including labor. Labor, it is found, is contributed freely to such work, at times when more important work is practically at a standstill. Were it otherwise the undertaking would be of doubtful merit.

Unless such mills can be put up at odd times, and and had it been possible to get a shopmade mill heavy enough to do the same work they would have preferred to buy, and thus avoid the care of planning, and designing, and building their own. This offers another justification for the homemade mill.

Many farmers turn old farm machinery to admirable account in windmill construction; in this way they secure the best of turned bearings, without cost, and, at a small outlay of capital or time, procure a good, cheap, and lasting mill.

Beginning with the lowest and least efficient mills, and running up the scale to those of higher efficiency and increasing specialization, we have first the Jumbo family, including Baby Jumbos, Medium and Giant Jumbos, and Screw Jumbos; second, Merry-go-round mills, including the mounted and unmounted forms; third, Battle-ax mills, including two-fan, four-fan, six-fan and eight-fan Battle-axes, and Giant Battle-ax mills; fourth, Holland or Dutch mills, small and large; fifth, Mock Turbines, which closely resemble the shopmade mills, including those with four, six, eight, and many fans, and the Giant Turbines; sixth, reconstructed Turbines, with and without rudder. At

same with straw which was burned so as to unsolder the tops, bottoms, and sides of the cans, this farmer found himself with several hundred pieces of tin which he nailed to the loose sides of his Jumbo box. This was counted an interesting case, and others might be cited, but this is quite enough to verify the statement that these mills can be constructed largely of old or even of waste material such as is common to almost any farm. If the Jumbo cannot be built cheaply, and by one's own labor, it were better not built at all. This is not literally true, for any mill is better than no mill, but some other form of mill could be chosen to advantage.

The Jumbo can be used advantageously, as is illustrated by its practical operation all over the State, to pump water for the house, or for the stock, or for the irrigation of small patches of orchard or garden. For the irrigation of large tracts it may not amount to much, but touching this point it may be well to remember that if one small Jumbo can irrigate a small patch, several large Jumbos could irrigate a much larger one.

We have seen the Jumbos varying in size and strength from those at work pumping water for the irrigation of the garden of a town lot up to those which were irrigating ten acres of orchard. If this much is already possible, more is to be expected. Several Jumbos, if well built, would do not a little service in field irrigation, especially if the water was first pumped into a storage reservoir, and thence into the furrows. And its usefulness might be still further enhanced by using it steadily during the fall and winter in order to get the ground well soaked.

Some irrigationists in the State purchase their water rights in the fall and winter for the reasons: first, that there are fewer using water at that season and it is cheaper; second, by flushing the fields, fall plowing is made easy; third, by wetting the ground thoroughly at this season, it is considered by many to virtually insure the crop. If the best use is made of the Jumbo, the results are not to be despised.

This is not to be construed as a statement that much

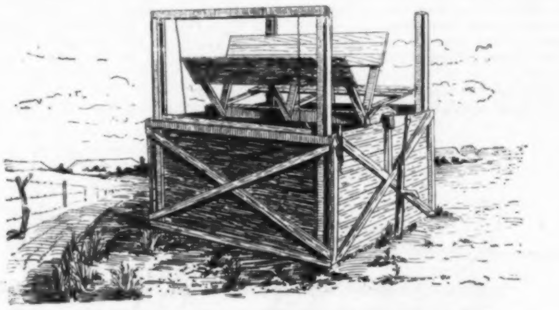


FIG. 5.—A model built by the writer, showing how the wind guard or cut-off may be the side of the Jumbo box itself, which raises or lowers on the uprights. It would be easier still to hinge it so as to lie flat upon the ground, thus stopping the mill.

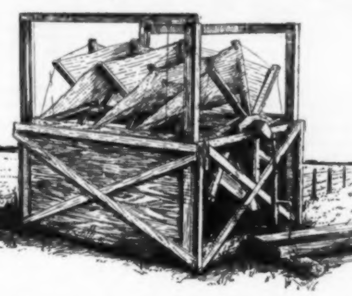


FIG. 6.—The Screw Jumbo. This is a rare form, but two examples being known in the State. These mills are almost as efficient in east and west winds as in north and south winds. The wind guard is the side of the windmill box itself, which is raised until air is admitted below as well as above the fans, thus checking or stopping the mill according to the position of the guard. Drawn from a model built by the writer.

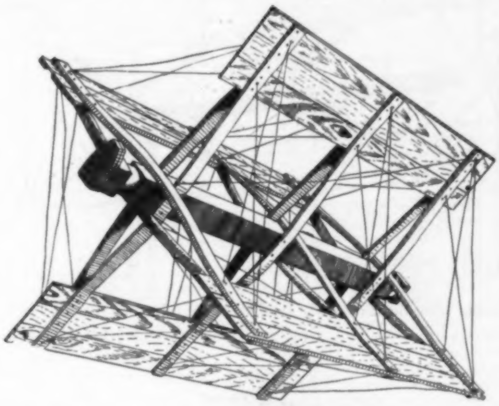


FIG. 8.—A figure to show how the arms may be attached to the axis without weakening it. The fans may be given great rigidity by cross-bracing with twisted wire. Drawn from a model built by the writer.

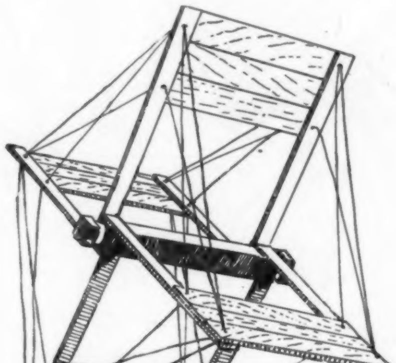


FIG. 7.—Plan for the working parts of the Baby Jumbo. Arms, 3 to 5 feet long; axis, 4 to 6 feet, to be made of wood or gas pipe, as preferred. Fans to be 3 to 5 feet long and 2 to 3 broad, according to the length of the arms. The fans should cover about one-third of the arms. Six fans are preferable to four.

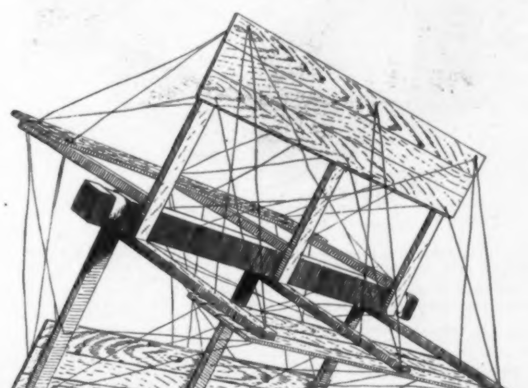


FIG. 9.—A method of attaching arms which is at once cheap, strong, and of easy construction. The whole is tied together and cross-braced by twisted fence wire. Drawn from a model built by the writer.

made out of material at hand, by which is meant old lumber, poles, and hardware common to every farm, they are better left unbuilt, for they defeat the very ends for which such mills exist. Let them be built cheaply, or not at all.

Some builders, by a display of superior management, erect excellent mills, sometimes without cost, at other times at a merely nominal expense of one or two dollars for extra lumber and hardware. We have seen mills doing good service on market gardens which cost but one dollar and a half; we have seen them on large farms where each mill was pumping water for the cattle on each quarter section, and yet such mills did not cost more than a dollar and seventy-five cents. This is getting good service at a very small cost. From this up there is every gradation in price to mills costing one hundred and fifty dollars, with an efficiency of eight horse power, and capable of grinding food for the stock at the rate of two hundred to three hundred bushels of grain per day, according to the wind. This last is the most expensive mill known as yet in the State. However, the work it performs seems to be commensurate with its cost. Similar mills costing fifty dollars ground one hundred bushels per day.

The owners of these mills were farmers of wealth, the head of this series should come a seventh group, the regular shopmade mill.

THE JUMBO WINDMILL.

The Jumbo mill, or Go-devil as some call it, is very like an old-fashioned overshot waterwheel. It is simply a sort of overshot windwheel.

We have taken the liberty of putting it in the lowest group of mills, where it probably belongs, although in talking with their owners, it is plain that they defend these mills, and would put them in a higher class. All of which speaks well for this simple and useful mill. However, as a matter of fact, they are probably the least efficient type.

This must be said, that they lend themselves readily to construction, being very simple in design. Furthermore, almost any kind of material may enter into their make-up, so they are economical. We have seen old lumber, lath, shingles, split rails, old packing boxes, barrel staves, coffee sacks, and even tin from old tin roofs pressed into service in the construction of these mills. We even found the tin can doing service in this capacity, for one farmer living near a small town found hundreds of old tomato cans in the dump near his place. Raking these into a heap, and covering the

of agricultural importance is to be expected in this direction, although a great deal seems possible. In point of price our Jumbos range from the baby Jumbos which cost nothing, or at most but a dollar or two, to the medium Jumbo costing four or five dollars, even to the giant Jumbo which costs one hundred dollars and irrigates ten acres of orchard.

The baby Jumbo, as the name implies, is a very small mill, so small that they at first passed for playthings, but the author finds that they are put to very good account. They are generally mounted upon abandoned towers, or upon buildings, while the large Jumbos are set upon the ground, and securely anchored there; all being so set as to catch to best advantage the prevailing wind of the place, which is north and south in Nebraska.

In Havelock, Neb., we find a baby Jumbo built by W. W. Iler, which has fans but three feet long, with arms two and one-half feet long; so that the fans are a foot shorter than the foregoing. For all that it does considerable work, and we have a practical measure of its efficiency in that it pumps the water for the stock, and for a boarding house or sort of private hotel having thirty regular guests. What more is to be asked of a mill which cost its owner and builder but three dollars and seventy

cents? It has this advantage, that it is set upon a tower sixteen feet high, so catches the wind. In a strong wind this little mill has pumped as much as three or four hundred gallons in forty minutes, lifting it sixty feet, as measured in barrels by the owner. Whether accurately or approximately measured, it is plain that the little mill is doing a big work.

Its real usefulness to the household is borne in the more forcibly when the wind shifts to the east or west, and they are compelled to pump by hand the water necessary for so large a house. Later the true efficiency of this mill will be measured and reported. Other Jumbos in other parts of the State are almost as small, but as far as is now known, this must be reported as the baby of all.

Next in size comes the remarkable Jumbo designed and built by J. L. Brown, owner and proprietor of the Midway Nurseries near Kearney, Neb. It cost but one dollar and a half, spent for its gas pipe axis, yet it pumped water enough for the successful irrigation of the garden, strawberry patch, and small fruit during the most trying season of drought ever experienced in the State. Without it everything would have been a failure.

The fans and Jumbo box were built almost wholly of the sides and ends of old grocery boxes, thus securing a maximum of usefulness at a minimum of cost.

This mill reverses the ordinary proportions, in that it is narrow and tall. Its proportions are, height ten feet, width three feet. Box three feet wide, nine feet long, six feet high. The pump stood about five or six feet from the mill and was connected with it by a lever that, where there are but four fans, it often happens that they are in such a position, as they revolve, that but a single fan is struck by the wind at a time, whereas in the case of six fans and eight fans, two, three, or four may catch the wind at a time, thus giving the mill just that much additional strength.

A Jumbo mill carefully built was found doing good service in watering a six acre patch of egg plants grown for the Lincoln markets (Fig. 3). This was on the farm of W. W. Goodrich, of Bethany. In one respect this mill was unnecessarily well built. All mills ought to be equally well built, bolted together, anchored, and braced; but as the builder himself says, it is not necessary to have a Damascus steel axis with turned bearings, oil cups, etc. A gaspipe axis, he says, would have served the purpose as well, and would have reduced the cost of his mill from eight dollars to three.

This is a six-fan Jumbo, each fan being nine feet long, with a radius or arm five and one-half long, the whole mounted upon a box nine wide by eleven long, by six feet high. As the fans of a Jumbo revolve rapidly within the Jumbo box, it is believed that there is so little room in a well made box for the escape of the compressed air that it forms a sort of air cushion, which to a certain extent checks and retards the fans. To overcome this difficulty, Mr. Goodrich has resorted to the simple device of having the bottom of the Jumbo box consist of two doors, hinged in the middle, so that one can be lowered when the wind is from the south, the other when from the north.

The two mills of the Travis brothers, Lincoln market gardeners, were observed in practical operation for and relatively deep. It was one hundred and fifty feet long, four feet wide, and two feet deep, skirting the edge along the highest part of the patch. There was enough grade so that the furrows were quickly flooded, and the water cut off and turned into successive rows. In this mill, for the first time thus far, we see an attempt at a regulator for the Jumbo.

Inspection of the cut (Fig. 4) will show an upright support at each of the four corners of the Jumbo box, each support carrying a pulley and cleat; below one can make out a sliding door, which may be raised and lowered so as to cut off, more or less as needs be, the force of the wind from the fans, thus regulating the mill to winds of varying velocities. This increases very materially the labor and expense of such a mill, for it is equivalent to doubling the lumber on both of the sides. Besides, it is of questionable utility anyway, for most Jumbos are built without any wind guard or cut-off. If such an arrangement is desired, it is cheaper and simpler to have the two sides of the box itself adjustable. By raising the side next to the wind the speed of the mill can easily be regulated, or the mill can be stopped altogether. (See Fig. 5.) Or a still simpler method would be to let the sides have hinges at the bottom so that they could easily be let down upon the ground, which would stop the mill.

There will then remain yet another important limit, namely, the Jumbo is set permanently to face the north and south, that is, in the direction of the ordinary or prevailing wind; accordingly, it is literally thrown out of gear when the wind is from the east or west. Some have overcome even this difficulty, and

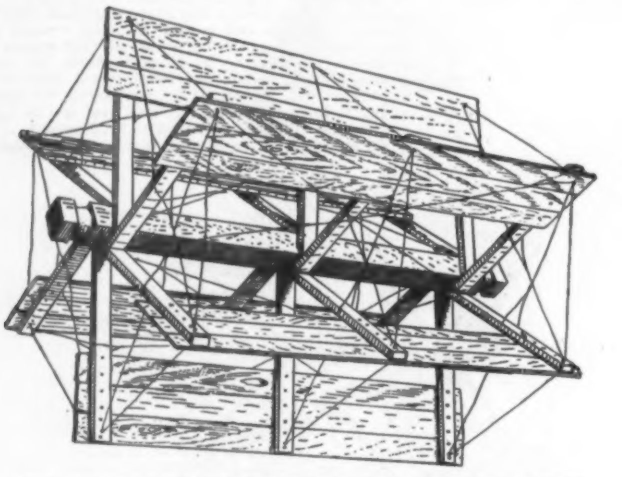


FIG. 10.—The construction of a six-fan Jumbo with a wooden axis, cross-braced by twisted wire. Size, 12 to 14 feet long; 10 to 12 feet in diameter. Drawn from a model built by the writer.

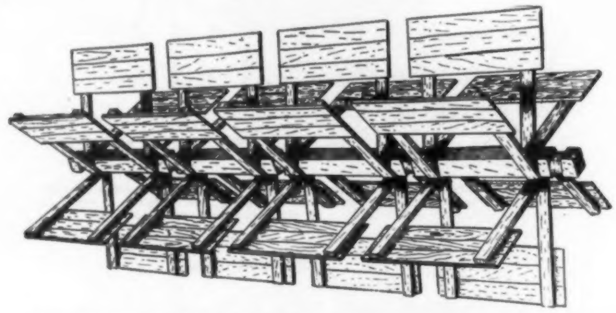


FIG. 11.—The construction of gangs of Jumbos as proposed by the writer. Diameter, 12 to 14 or more feet; length whatever desired. Thus Jumbos of unlimited size are possible. Each section is designed to be 6 or 8 feet with a support, instead of 18 feet long, as is a common and very misguided practice. The writer would suggest two sections for ordinary Jumbos, with a support in the middle; thus the axis would not sag or break so readily, if at all. This is a means of making powerful Jumbos, as the writer believes, especially if chain and bucket are used instead of pump. In regions of shallow wells, these might be used for irrigation on a larger scale than is possible with the ordinary Jumbo. Drawn from a model built under the direction of the writer.

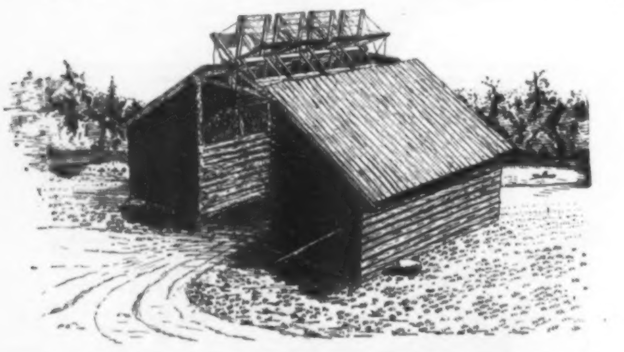


FIG. 12.—A sketch to show that an indefinite number of Jumbos may be arranged in a gang, and that corn cribs and sheds may be used for their support, thus reducing the cost merely to the lumber in the fans, arms, and axis. Powerful Jumbos may be built in this way at small expense. Diameter, 12 to 14 feet; length of axis, 28 to 30 feet, supported at five points. The fans are slowed down by a brake, and are then tied as is a common practice. Cut-offs or wind guards are omitted, it being assumed that the mill is built well enough to breast storms and wind. Drawn from a model built by the writer.

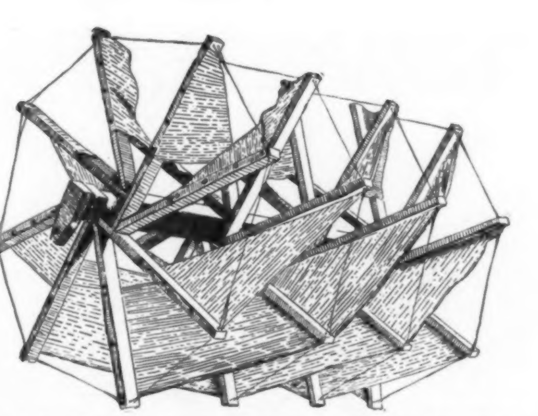


FIG. 13.—A figure designed to show the construction of screw Jumbos. The sails are of canvas; the arms are braced and tied together with twisted wire. Drawn from a model built by the writer.

in the ratio of five or six to one, which gave it an advantage.

When visited, a fair wind—probably a ten mile wind—was blowing, and it was pumping vigorously, and continued to work with undiminished force after an additional load of one hundred and fifty pounds was added to the pump rod. It was not overloaded by more than two hundred pounds or more. Means were not at hand for the measurement of its true efficiency, which Mr. Brown estimated for us by saying that the profits from that small mill, during the three distressing seasons of drought, probably exceeded that of the place.

This mill serves our purposes doubly, in that it furnishes exact figures respecting a mill built by carpenter and blacksmith, and out of new lumber. This mill with a Jumbo box six feet by eight feet by twelve feet, supporting four fans on an iron axis, cost just eight dollars. The four fans were each six feet square, boarded up solidly. Had there been six or eight fans with but two or three boards, instead of five or six, the results would have been far better, and it would serve as a model. However, as it is, it serves its owner well, and helps to pump water for one hundred head of cattle. This new mill was built to replace an old one put up three years before and kept in constant use. The owner expects the present mill to pump the water needed by his herd, and expects its term of usefulness to be fully five years. If so, he will be paying for his water service at the rate of about one dollar and a half a year, and the lumber will be in such preservation that by very little rejuvenation the mill may be made use of again.

Many are convinced that the Jumbo mill is the preferable type, and for all such it ought to be explained several months. Their size, rough construction, and numerous crudities, render them nearly typical Jumbos. The two mills watered not far from eight acres, but it must be remembered that the demand for water in the most humid part of the State is less than would be the case further west. Thus the mills make just that much better showing. In eastern Nebraska, as is so well known, it rains at that most propitious time, the growing season, continuing through April, May, June and July. Accordingly the mill is pressed into service irregularly, to tide the garden truck over a dry week. And indeed this is the function and the hope of the windmill as related to agriculture. It is not expected that the mill can do the work of irrigation all the time, but rather at the critical time. Let the mill run all the time if need be, but let the water run from the storage reservoir only at the trying time. Managed thus, good returns are to be expected of the windmill in agriculture as well as gardening, but of course in a limited way.

These two mills cost respectively eight and eleven dollars, and if there had been a demand commensurate with the large crop resulting from the use of the two mills, the owners say that nothing more could have been desired.

Mill No. 1 (Fig. 4), which irrigated about five acres, had a box nine feet wide, thirteen feet long, and eight feet high. Each of the four fans was of burlap or coffee sacking, nine feet by four feet. This was stretched upon arms six and one-half feet long. The mill kept the reservoir, which was a unique one, well filled.

The peculiar or original feature of the reservoir lay in the fact that being built where land was valuable and space must be economized, it was built long, slim, have built universal Jumbos; Jumbos which, though set in a fixed north and south position, run almost equally well from whatever quarter the wind blows.

These are the screw Jumbos, of which but two examples are known in the State, one at Trenton, Hitchcock county, built by Mr. C. R. Powers; the other at Ainsworth, Brown county, built independently by Mr. Baldwin. The fans of such mills are of duck stretched along diagonally opposite arms in such a way as to make a veritable screw, whence the name.

The wheel was eight feet long and ten feet in diameter. The sails were made of heavy muslin, tacked above to a strip of board, below to rope, so they could be furled. The cost of this mill, which lifted water from a ninety-six foot well both for house use and for irrigation, was ten dollars.

The Jumbo box was entirely open on the ends. Mr. Powers says that the screw Jumbo runs more steadily than the ordinary type. Both the builders of these mills speak in praise of their action.

(To be continued.)

As the result of an investigation undertaken for the purpose of determining the harmfulness of boric acid and formalin when used as preservatives of milk, Annett (Lancet, November 11, 1899, p. 1282) has found that these chemicals, when so used are injurious to the health of the consumer, and particularly so to that of young infants. Further, it is easy to conceive that the great mortality rate among infants from diarrhœa in many large towns may be closely connected with the practice, especially during the summer months, of systematically "doctoring" milk by means of the preservatives used by milk purveyors, dairymen, and milkmen.

THE GEOLOGY OF THE KLONDIKE REGION.*

By J. B. TYRRELL.

THE Klondike region, as far as it is known to be rich in gold, has a total area of about 1,000 square miles. It is bordered on the west by the Yukon River, on the north by the Klondike River, which flows into the Yukon from the east, on the east by the great valley of Flat Creek, and on the south by the watershed between the Stewart and Indian Rivers. In past geological ages it was a rough and mountainous country, but the mountains have been eroded to gentle slopes, so that now the country is a series of vast swelling hills and deep intervening valleys, with a greatest relief of about 3,000 feet, and a greatest elevation above the sea of about 4,000 feet. The dome is the highest point of a high ridge near the center of this area, and from about it valleys radiate in all directions toward lower country. The rocks underlying this whole region can very rarely be seen, but hills and valleys alike have a thick coating of decomposed rock, which forms an excellent soil for trees and shrubs. The creeks on which gold was mined last summer were Bonanza, with its tributary Eldorado, Hunker and Dominion, which have a total length of about 60 miles. Rich prospects were reported from many of the other creeks in the vicinity. The total number of claims worked on the above creeks was about 200.

The rocks underlying the known gold-bearing area are micaceous and sericitic schists and quartzites cut by many small and some large veins of quartz. In places the schists are also cut by extensive dikes of dark green basic rocks, and by lighter colored acid porphyries, but it is not probable that these latter have any influence on the value of the gold contents of the rick. On Bonanza and Eldorado Creeks one band in the schist is highly graphitic. The schists are undoubtedly sedimentary rocks of early Paleozoic, probably of Cambrian, age, which have been highly metamorphosed, the quartz veins having probably formed in them during this metamorphism. They are not greatly disturbed, but appear to lie in wide and gentle folds. Near the dome they are approximately horizontal, apparently on the summit of a diffuse anticline.

The Klondike schists are probably the southeast continuation of the Birch Creek and Forty-Mile schists, which have already been traced to some extent in Alaska. Farther south, in Canada, they have not been clearly followed, though it is not improbable that many of the schists, quartzites and limestones underlying the country along the Dalton Trail and westward to near White River are of approximately the same age. I saw specimens of coarse gold which had been brought from the Kasha River and its tributaries, where the country is probably underlain by mica schists not unlike those of the Klondike region. As yet very few traces of gold in these rocks have been found. The gold is concentrated in the recent sands and gravels on the banks of the rivers and in the beds of the smaller streams, as well as in stream-terraces and moraines on the sides of the valleys.

In the bottom of the valley of Bonanza Creek, as well as in the bottoms of most of the surrounding valleys is a deposit of well-rounded gravel from 6 to 20 feet or more thick, lying on the bed-rock, which is often very much decomposed. Many of the pebbles are of white quartz, others are of the schist, but all are of local origin. The sand and gravel are usually well stratified, and often contain bones of the mammoth bison, bear, musk ox and other animals, and fragments of wood, as well as occasional peaty layers. The gravel is usually overlain by several feet of peat or sphagnum, on which may be a growth of small black spruce. Scattered though the gravel, but more especially within a short distance of the bed-rock, are nuggets or particles of gold varying in size from a medium-sized potato to very minute flashes. The gold usually extends down 1 or 2 feet, into the bed-rock, and this bed-rock is raised and washed with the richer portions of the overlying gravel. On the sides of some valleys benches of well-rounded gravel, similar to that in the valley bottoms, are found extending 50 or 60 feet up the hills. This gravel is stratified and clearly waterlain, and in a favorable locality may be rich in gold.

On Bonanza and Eldorado Creeks, more especially on their western sides, some very rich claims have been located in a lateral moraine which extends along at a height of about 200 feet above the bottom of the valley. The rich hill claims near the mouth of French Gulch are located on this moraine, which, however, has been here largely formed by a stream running between the glaciers and the sides of the valley. The gold is found at the bottom of a bed of coarse sand containing rock-flour, sand, pebbles and bowlders, not well rounded, but rather of glacial shapes. The gravel is more or less distinctly stratified, and the pebbles almost always lie horizontally. The gold, often in large nuggets and including much quartz, is usually rough and but little water worn.

The conditions which would seem to have prevailed when the gold was deposited are simple and clear. The rock with its included gold had decayed to a considerable depth, and this decayed material had gradually crept toward the valley bottoms. When great ice-sheets covered much of the country to the south, small local glaciers formed in the heads of the valleys and flowed down. These glaciers were, as a rule, thin, that in Bonanza and Eldorado Creeks being only about 200 feet thick, through much of its length. The glaciers cleared most of the decayed rock out of the lower parts of the valleys, while the torrential streams from their feet sorted and left the gold and well-rounded gravel as a typical glacial wash in the bottom and on the lower benches. Thus it is seen that the gold is derived from rock close at hand; that it weathered out of this rock during the progress of ages; and that small local glaciers, with the torrential streams flowing from them, assisted materially in concentrating it in the valley bottoms. In valleys that have not been occupied by glaciers it is hardly probable that the gold will be so richly concentrated, even if the underlying rock should be equally rich. The streams are all flowing over these beds of rounded gravel. I did not see an instance where one had cut down to bed-rock. The gradients of the main valleys are not steep. Bonanza Creek from the Forks to Klondike River has an average slope of 40 feet to the mile, while above the Forks the slope increases to 100 feet to the mile. Eldorado Creek below the mouth of Chief Gulch has a fall of rather more than 100 feet to the mile.

While the gravels in the valley bottoms vary in thickness from 6 to 20 feet or more, the gravel and clay on the hillsides are sometimes more than 50 feet thick.

As the surface is often covered with peat or vegetable matter, keeping out the summer warmth, much of the ground is frozen. A depth of over 100 feet of frost has been reached in some places. The extent of the country penetrated by permanent frosts is not known, but probably many of the drier and more open benches are free from frost in summer. A little farther south, along the Dalton Trail, all the drier and more open country was free from frost in summer, as was shown by its being riddled with the holes of ground squirrels, who clearly could not live in permanently frozen soil.

Shaft sinking and drifting are done in winter by building fires on the frozen gravel. In summer, when fires would melt the sides of a shaft, red-hot stones are used. Where water is plentiful, as on the banks of the larger creeks, the material raised is washed in short sluices, and most of the gold is caught without the use of mercury. Hand rockers are used where water is scarce. Last summer many of the principal claims were worked by a system of open cuts or diggings. The surface peat or muck was removed, either by digging it up or by cutting a number of narrow channels through it and sweeping it off by turning on the water of the creek. The summer heat quickly thawed the surface of the gravel, and as fast as it was thawed it was scraped off and thrown into the sluices. A small amount of water might seep into the pits thus dug, but was easily removed by some kind of rough pump, the commonest being a continuous band with dippers, run by a rough water-wheel.

As the small and very rich claims are gradually washed out, there will remain a great quantity of gold to be recovered by grouping the claims and washing the gravel by cheaper methods. The decomposed rock covering the hillsides contains a certain varying amount of gold, and this can in many cases be washed and recovered by hydraulic processes. The frozen clay and gravel, when exposed in summer, thaws very quickly, leaving the material in a loose and friable condition. In this state it might be very quickly washed off the hillsides by any good stream of water which could be brought to bear upon it, especially if this stream could change its point of impact slightly from hour to hour. The lower portions of Hunker and Bonanza Creeks could probably be washed by water brought from the Klondike River, while the higher portions could probably be supplied with water from reservoirs at the heads of the creeks themselves, which could be used after the creek claims had all been washed.

Much of the country is well wooded with white and black spruce, poplar and birch, which covers the bottoms and the hillsides to heights of about 2,500 feet above the Yukon River, or 3,500 feet above the sea. On the lower portion of Bonanza Creek is a forest of fine tall white spruce, many of the trees being 18 inches or more in diameter. If the wood is properly cared for, there is enough for all purposes for many years to come.

* Abstract of paper read before the American Geological Society at the December meeting.—From Engineering and Mining Journal.

THE BAD LANDS OF NORTH DAKOTA.

By RALPH S. TARR, Professor of Physical Geography in Cornell University.

PASSING westward on the Northern Pacific Railway, one crosses vast plains, gradually rising to the plateau which extends along the eastern foot of the Rocky Mountains. At first the train crosses the fertile farming lands of Minnesota and the wonderfully level wheat lands of the Red River of the North. But during the night the train passes from the humid plains of eastern North Dakota to the arid plateau lands of western North Dakota, so that, by morning, the traveler looks out upon a monotonous rolling plain, brown, desolate and uninteresting.

Very soon, however, the surface begins to have variety of form; for the Bad Lands are reached, and this is a region where there is a constantly changing panorama of sculptured hill slopes. The forms are weird, and often fantastic. One passes them by in such quick succession that a glimpse only is possible, for the eye has not time to appreciate the details, so that the mind receives a general impression of a panorama of marked interest and variety.

Very few people take the time to become better acquainted with this region, though many pass through it to spend time in seeing vastly less interesting places beyond. A stop of a few days at Medora, with a ride or two among the hills, will repay any one interested in nature. Not only is the variety of land form remarkable, but the geological history of this sculpturing is also interesting. It is of this that I wish especially to speak.

Toward the close of the Cretaceous period, when the Rocky Mountains, as they now exist, were being raised in series of vast earth folds, the warping of the surface formed a series of depressions in the region now occupied by the mountains and plateaus. Into these basins, which were in some cases estuaries and bays, arms of the sea, and in others lakes, streams, laden with sediment, poured their floods. Here in the quiet lake or ocean waters the rock bits were assorted and deposited, forming layers of clay, sand and gravel, which eventually accumulated to considerable depths.

It is these beds, now drained and elevated, that have permitted the development of the Bad Land sculpturing, and the fossils that they contain tell of their origin. Some beds are marine, some brackish, and some fresh water. Around the shores of these waters there existed plant life, often in great abundance, frequently in the form of swamps.

The evidence of the presence of this ancient plant life is complete. Every here and there one finds impressions of leaves, or the seeds of plants, or bits of wood embedded in the sand and clay strata; and frequently, too, tree trunks and tree stumps, with their branching roots, are found transformed to stone. Petrified forests are not uncommon in the West, and here, in the Bad Lands, is an excellent place to see them. The tree trunks and stumps have been buried beneath layers of sedimentary rocks; water percolating through these layers has dissolved silica, carried it on, and slowly deposited it in the place of the decaying wood. Molecule by molecule has the wood been replaced, and the replacement has been so well done that the wood texture, the knots, and even minute variations in grain have been preserved, though the wood itself has gone.

Even more impressive evidence of swamp growth on the shores of these ancient water bodies is found in the layers of coal. Exposed in the ravines which traverse the Bad Lands are innumerable coal seams, so that every ranchman in the region can have his own coal mine. Some of the coal seams are mere laminæ of carbonaceous matter intercalated between layers of clay; others are beds of pure coal, of good quality, and several feet in thickness. They are preserved peat beds and swamp deposits, formed on the shores of water bodies now destroyed. The coal of this age is found all over the Rocky Mountain region, and forms a vast and almost inexhaustible reserve supply, at present only very slightly developed.

When deposited, the layers of rock undoubtedly stretched from hill to hill across the space now occupied by the ravines; and no doubt the layers now exposed to view were then deeply buried beneath other beds now stripped off by the very processes which are even now plainly at work lowering the hills and broadening and deepening the valleys. The subsequent history of the Bad Lands is mainly one of sculpturing by the erosive action of wind and running water.

The carving of the surface, which has produced the marvelous variety of form characteristic of Bad Land topography, has been done primarily by the Little Missouri River and its tributaries. The Little Missouri has cut a valley into the partly consolidated strata of the region, and the tributaries to the river have likewise sunk their channels into the strata.

Because of the aridity of the climate, the hill slopes thus formed are only scantily clothed with vegetation. Rain is not frequent, but when it does come, the fall is often very heavy. Because there is no forest or sod to hold it back, the water runs quickly down the steep slopes, and with its rapid flow is able to cut channel ways in the partly consolidated strata. So the hillsides in this region are gullied and sculptured by the action of rain-born rills.

This rain-sculptured surface is one of the features of the Bad Land topography, and is one of the causes for the weirdness and variety of form. On a very small scale one may often see much the same result where the rain has carved the soft clays in a steep railway cut. But in the Bad Lands there are thousands of steep slopes, and on every one of them the rain has been engaged in gullying the surface. One may see the work that is being done during any heavy rain, when thousands of tiny rills course rapidly down the hillsides and bear to the Little Missouri a volume of sediment-laden water, representing the work of excavation which they have been able to do on the hillside. It is a work still in progress.

The variety of form in the Bad Lands is infinite as to detail, yet in general features one is able to see a certain system and relation of cause and effect. First, and of prime importance, are the river trenches, with the steeply sloping wall of soft layers, themselves gullied into great variety of form by the rain-born rills. This variety of form is influenced in an important way by the stratification of the layers, which introduce a second important determining cause for the form.

The strata are horizontal, and when in the region one very soon notices that some of the horizontal layers are very soft and quite unconsolidated, while others are hard and consolidated. Naturally, therefore, the difference in hardness of the horizontal beds introduces a horizontal element of control of land form. For instance, where the layers are hard there are steep slopes in the hillsides, and these precipitous sections may be traced horizontally around the hills and from hill to hill.

A second influence of the horizontal variation in hardness is very frequently seen when a harder layer caps and protects a hill. This protection furnished by the harder layers in horizontally bedded strata is one of the most important factors in determining Western plateau scenery. Streams cut valleys in the plateau, slicing through hard and soft layers and leaving hills between, composed of these horizontal beds of different texture. These inter-stream areas wear away slowly, and when one of the hard layers is reached it wears still more slowly. Since it extends horizontally, the effect of the retardation is to cause steep-sided hills with flat tops, called by the Spaniards mesas (or tables) if large and buttes if small.

Many of these flat-topped mesas and buttes near together reach the same level because determined by the same horizontal bed. Gradually even the hard cap-rock gives way under the attack of wind and rain, and the flat-topped butte changes to a cone, and finally either melts away, or, if there is another hard layer lower down in the hill, when this is reached it also resists the action of the weather, and the hill again becomes a butte with the flat top at the level of the lower and newly exposed hard stratum.

In the Bad Lands of North Dakota one sees every stage in the life history of buttes. There are plateaus, only here and there crossed by streams, and there are plateaus whose edges furnish numerous instances of hills nearly severed from the plateau by the cutting action of streams. There are also typical flat-topped buttes perfectly separated from the worn plateau; and nearby there are conical buttes in which the hard layer is nearly gone, perhaps with loose fragments of the hard rock resting on the hillside, as the only remnant of the cap-rock. Lower down in the hill may, perhaps, be seen other hard layers which, in time, will cap the same hill at a lower level. Indeed, nearby, this same lower layer may be seen furnishing a flat cap for buttes which have already melted down to this level.

One who takes a drive into these Bad Lands will have his attention called to the "scoria" rocks which abound there. These scoria layers are very striking, because on account of their hardness they are often found capping and causing buttes. The scoria layers are highly colored, often some shade of red, and they add markedly to the beautiful variety in color effect that one notices in the Bad Lands. Besides being highly colored and very hard, the rock is often clink-

ery, full of holes, and quite like many lavas in appearance, though sometimes the appearance is rather that of slag. The traveler may have some remarkable theory for the origin of the scoria thrust upon him, and it will require more than a passing glance to prove to one's gratification that it is not really a lava or an artificial slag.

In the true sense of the word the rock is neither lava nor slag. One can prove for himself what it is by visiting one of the burning coal mines where scoria are even now being formed. In these places one may see a fire set, perhaps, by Indians, or by a prairie fire started by lightning, or possibly set afire by spontaneous combustion. For years, since long before white men visited this region, these fires have been burning summer and winter, until now most of the lignite has been burned out of the dry hills, which have been stripped and exposed to the air by the action of the rains.

In such a place one sees a hill, cracked and fissured, with jets of sulphurous smoke issuing from the crevices, telling of the fierce fire that is raging within. It is not perfectly safe to walk about on this cracked surface, but by exercising care one may approach near enough to some of the cracks to look into the fiery furnace and see the white hot glow of the coal and the inclosing rocks, heated to a white heat like that of a blast furnace.

Here the rocks are being baked, indurated, and in places actually melted and caused to flow like lava. Here are being produced a natural slag and clinkers in one of nature's great furnaces, and the local name of scoria is, therefore, an excellent one. Fire, as well as water, has been important in determining the form of the Bad Land hills, and there are few other places in the world where one is able to see an illustration of this exact combination of causes for topography.

The Bad Lands of North Dakota are not altogether barren sculptured hill slopes. There are broad, grassy valleys and level upland plateaus. Moreover, the region is well watered by the Little Missouri. It is natural, therefore, that ranchmen have chosen this interesting region for a home, where, in the midst of the plains, their stock are protected from the fierce winds of the plains and where, amid the protection of the hills, they are able to find both water and food.

The Roosevelt ranch is not far from Medora, and the Eaton ranch is still nearer. If one has the good fortune to visit the Bad Lands as the guest of the Eaton brothers, he not only sees the wonders and beauties of the Bad Lands, but he receives an impression of ranch life and a ranchman's hospitality which will never leave him. One then feels that the term Bad Lands is a misnomer, for all excepting the sculptured hill slopes.—The Independent.

A NAVAL COMBAT IN MINIATURE.

ABOUT ten years ago, at the time of the Universal Exposition of 1889, a nautical spectacle was arranged by M. Solignac for a new Parisian circus, the ring of which, for the purposes of the representation, was temporarily converted into a small lake. Half a score of small armor-clads, surrounded with appropriate scenery, gave the illusion of a naval combat, and what was very interesting and remarkable was that there was no one on board. Notwithstanding this, the ships performed their evolutions in all directions, fired guns, caught fire and sank after an explosion, etc., all under the management of one man, who stood in the wings and had under his hand a keyboard connected with the source of electricity.

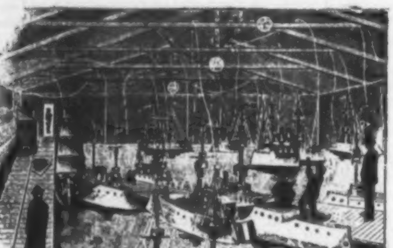


FIG. 1.—THE ARSENAL IN THE WINGS, IN WHICH THE BOATS ARE HOUSED.

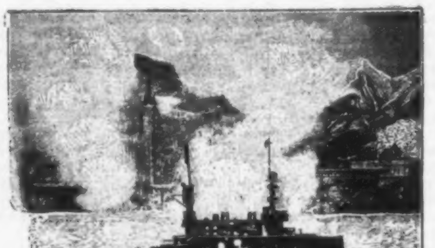


FIG. 3.—THE BOMBARDMENT.

The use of a continuous current and polarized electros or of an alternating current and high tension permitted of obtaining all the effects with but two wires.

As the Exposition of 1900 approaches, we find ourselves in the presence of another naval combat, but this time on a larger scale. In order to obtain the space required for a vast basin, it was found necessary to go outside of Paris, and so the public will have to make the acquaintance of the Porte des Ternes road. Not far from the fortifications, on a vast extent of ground, there has been excavated a lake of over 350,000 cubic feet (2,640,000 gallons) capacity. In the distance is seen the roadstead of an important city (Fig. 2), while some well executed scenery, extending all around, shows us steep mountains armed with forts.

The supplying of this city with provisions and ammunition is to be attempted by a merchant vessel escorted by ships of war and protected by the forts, while the enemy's squadron, composed of torpedo boats and armor-clads, is watching the roadstead and endeavoring to cut off all communication. Hence results a battle between the vessels and a bombardment of the city and forts.

The spectators occupy a stage 360 feet long, erected along the edge. The ships give a very exact impression of French armor-clads seen from a distance—from too great a distance, in fact; for the fault that is to be found with them is that they are a little too small. The programme assures us that they are 26 feet in length, but the length is scarcely half of that. In one of the wings is the "arsenal," in which they are housed and prepared for their entrance upon the stage (Fig. 1).

The boats are maneuvered as follows: Each of them is provided with a battery of Dinin accumulators, an electric motor, a screw and a rudder (Fig. 4). Being from 10 to 13 feet in length, they are capable of carrying several persons; but, in reality, there is, we think, but one man on board. To say that he is comfortably installed would perhaps be going too far. He is seated upon the accumulators and holds in his hands a handle bar with which he actuates the rudder. Near him is placed a lever that permits him to introduce resistances into the circuit in order to obtain different speeds, and to reverse the current in order to move backward and forward. Another commutator is used by him for lighting the incandescent lamps placed at the top of the masts and that have to represent projectors or signals. Finally, within reach of his hand, there is a large revolver loaded with blank cartridges, with which he does the bombarding (Fig. 3). In order to enter the boat, the "admiral" removes a part of the deck corresponding to a turret, or any other important superstructure, and which, after he has become seated, is put back in place. His head and shoulders are concealed, while numerous portholes or other apertures (or a piece of painted wire gauze, if that be necessary) permit him to see things around him and steer his vessel.

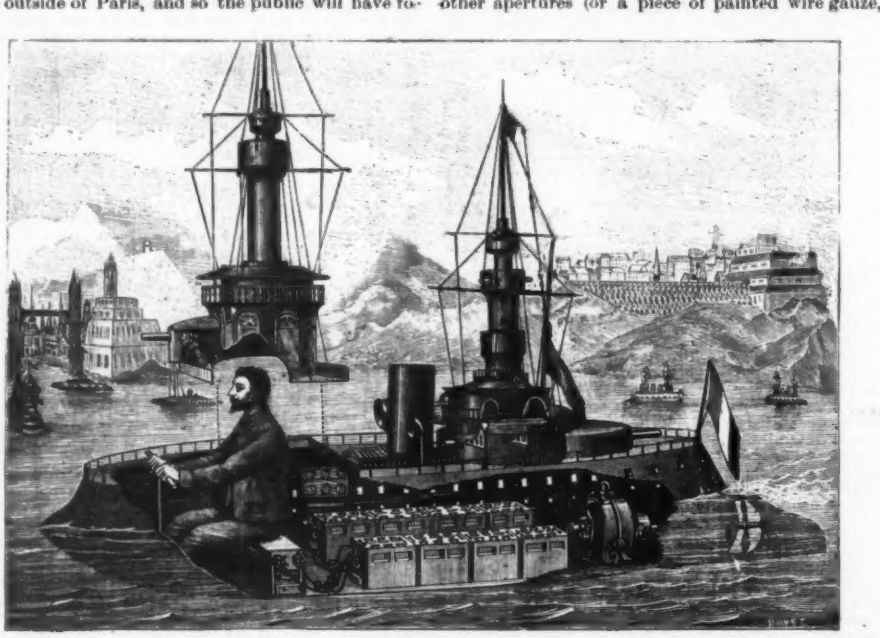


FIG. 4.—INTERIOR OF AN ARMOR-CLAD WITH ITS "ADMIRAL."

There are, however, some boats (those that are to sink) that are not so complete. In those that make but few evolutions there is no machinery, and these are carried by a man who walks in the shallow water with the boat upon his shoulders, and who at the proper time ignites the Bengal light that is to imitate a fire, and then causes the vessel gradually to sink according to the arrangements that have been agreed upon. He afterward retires in making a dive and coming up at a few feet distance. In the evening, however, as everything is plunged in darkness and smoke, he can easily conceal himself; yet not sufficiently to prevent himself from sometimes being seen. Upon the whole, the spectacle is well arranged, and although grown persons find it somewhat lengthy, it will certainly cause pleasure to the young sailors who frequent the basin of the Tuileries. In the evening the effect is much more interesting, and the fête terminates with a display of Bengal lights, petards and skyrockets.

For the above particulars and the illustrations, we are indebted to La Nature.

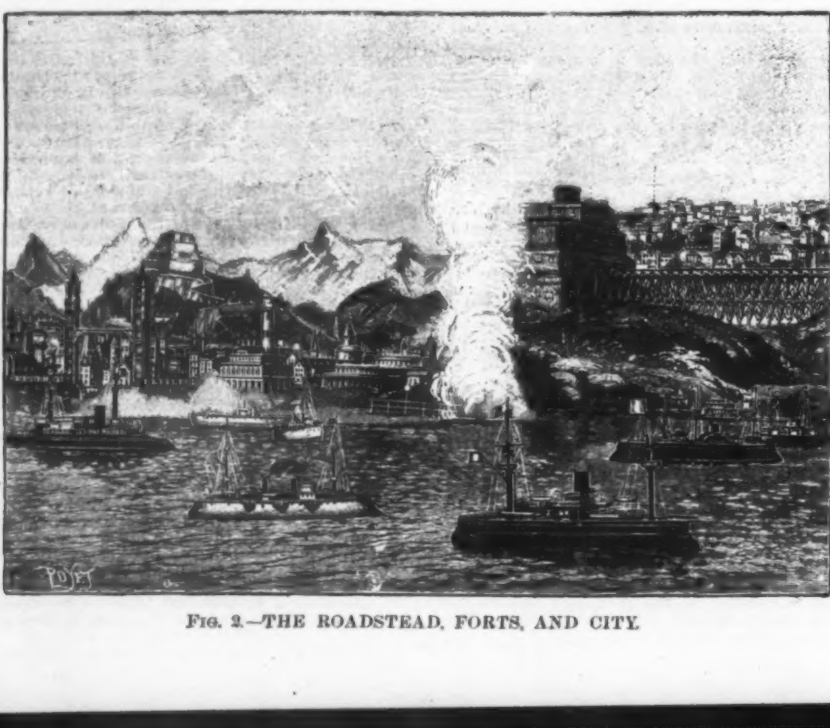


FIG. 2.—THE ROADSTEAD, FORTS, AND CITY.

GERMAN RAILROADS IN WAR TIME.

"IN time of peace prepare for war," is an old motto which is as good as it is old; and if we had made as much of it as the Germans have during the last thirty years, we should not have had our transport facilities in the hopelessly muddled condition that they were during the war with Spain.

I will give two instances or items showing what the Germans are doing and what we should have done; which is to say, what we should now do.

In Germany, as in the United States, the railroads are under various directions, corresponding with their various ownerships—the latter mostly governmental. But there more than in America the principle is recognized that the good of the whole must—especially in time of war—override all other conditions. Situated as one is, like a nut between the jaws of the crackers (France and Russia), it is necessary not only to defend her frontier by fortifications and permanently garrisoned frontier troops, but also to be able to throw her entire available force on either frontier at the shortest possible notice—and "short notice" in German military matters means a very insignificant period of time.

If we consider the difficulties which we should have to meet, had we to move 100,000 soldiers with all their appurtenances—cannon, horses, ammunition, pontoons, ambulances, field hospitals and kitchens, field telegraph stations and apparatus, etc.—from Chicago, Detroit, St. Louis and New Orleans to Boston, New York, Philadelphia and Savannah, we can well imagine that two weeks would not suffice for the work, if notice were given to-morrow. There may be a second Thomas A. Scott in embryo or in petto, ready to be discovered and utilized, to make the best of bad facilities and evolve order out of confusion—that is one order out of twenty conflicting orders—and such a one, were he found, would probably work wonders with the material at hand, and under the circumstances. But that does not lessen the fact that the material is insufficient, and the circumstances in the highest degree unfavorable.

The couple of instances which I here cite, out of a score which occur to me, are with reference (1) to the material, and (2) to its handling.

There are thousands of "third class" cars in the various kingdoms which compose the German empire, and the railroads of which form the German "peace railroad system," which are so arranged that twenty minutes suffices to transform each of them into a well-equipped car for transporting horses. The end access doors, which are of the double-flap folding type, are screwed to; the glazed window-sashes and their frames, which are only screwed on to the inside of the car sides, are removed; a section of the side falls out, when unbuttoned or unscrewed; the door rails are there, and the section of the side becomes a sliding side door. The transformation is complete, prompt and systematic. Printed directions for its accomplishment by the soldiers or by the railroad employes are at hand.

I come now to the time-table question. Germany is not so large but that if war were declared at noon to-day, the last train from a foreign country, entering it from one side, could not be cleared at the other boundary in forty-eight hours; and in the same time freight trains could be notified that a new regime would soon come in. After that period, during which time the materials of war would be assembled at the various railroad shipping points, no blocks would occur which would prevent the prompt forwarding of men and munitions. There lies sealed up in every railroad station in Germany the "General Railroad War Time-Table of the German Empire," which takes effect forty-eight hours after the declaration of war by Germany on any power, or by any power against Germany. This provides for the total suppression of all passenger and merchandise traffic and the conduct of the German military railroad system as an imperial unit, the principal object of which—in fact, the sole object—is to carry soldiers and war material. If there is any place in between, then passenger and non-military freight traffic may be carried on; but the army and its needs are the main thing, and every conductor, engineer or other railroad employé becomes after the forty eight hours an employé of the General War Railroad System. ROBERT GRIMSHAW.

Dresden, Germany. —The Railroad Gazette.

THE LAYING OF A FIFTY-NINE FOOT RAIL.

THE fact that there is a tendency on railways to increase the strength of the tracks, and, at the same time, the weight of the rolling stock, has already been pointed out. Thus, for rails that were formerly but 19·6 feet in length and weighed about 22 pounds to the running foot, there have been substituted others weighing nearly 110 pounds and reaching lengths of 33, 39, and even 59 feet. It is rails of the last mentioned type that are now being laid upon the new Courcelles line at the Champ-de-Mars. It takes twenty-four men to lift and put in place one of these long pieces of steel exceeding 1,750 pounds in weight. This operation, which is performed with military precision, presents a picturesque aspect. The advantage of these long rails resides in the suppression of a large number of joints, which are the principal cause of the repeated shocks which are familiar to everybody, and which produce a strain upon the track and rolling stock and fatigue travelers.

The joint itself has been very sensibly improved. On ordinary tracks, the extremities of the rails are connected by fish-plates, which are bolted to them on each side. Such a joint, however carefully it may be formed, does not prevent an unequal flexion of the two extremities of the rails upon the passage of every wheel, and hence a series of shocks, which are so much the more pronounced in proportion as the speed of the train is greater and the track is more strained. In the new joint of the Railway of the West, the fish-plates are of considerable length (5 feet instead of 18 inches) and weight (316 pounds per pair instead of 35 pounds). They rest upon three successive ties, thus forming a sort of bridge, and, with the rails that they connect, constitute a whole which is absolutely non-distortable.

For the above particulars and the engravings, we are indebted to L'Illustration.

FIG. 2.—LAYING A 59-FOOT RAIL—SECOND OPERATION.

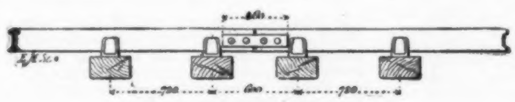


FIG. 3.—OLD JOINT.

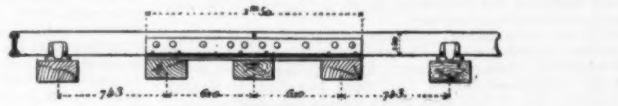


FIG. 4.—NEW JOINT.

DYEING HAIR AND FUR.

MEANS were described in recent German patents, says The Textile Manufacturer, for producing brown, gray, or black shades on hair or furs, by first impregnating them with solutions of certain aromatic amido, diamido, or amido-oxy derivatives, and then treating them with oxidizing agents. The bisubstituted benzine derivatives, such as para-phenylenediamine, dimethyl-para-phenylenediamine, para-amidophenol, and methyl-para-amidophenol, which have hitherto been used for dyeing hair according to the above processes, contain their active groups in para position to one another; and it may therefore be concluded that such constitution, allowing the formation of quinonoid oxidation products, was considered essential for the production of the colors in question on hairs or furs. It has lately been discovered that animal hair can likewise be dyed by using ortho-amidophenol and certain of its substitution products instead of the above-mentioned para derivatives. The colors obtained by means of these ortho derivatives are distinguished by their yellow tint, which cannot be obtained by using the para derivatives above mentioned. Ortho-amidophenol and its substitution products can also be applied with advantage in admixture with other easily oxidizable substances, such as pyrogallic acid, para-amidophenol, para-phenylenediamine and the like; these mixtures likewise produce on hair or furs the yellower tints which are frequently preferred to the brown shades obtainable by means of the materials hitherto used. Results of practical value have been obtained by using the following derivatives: Ortho-amidophenol, 4 chloro-ortho-amidophenol, 4: 6 dichloro-ortho-amidophenol, 4-nitro-ortho-amidophenol, 4: 6 dinitro-ortho-amidophenol, 4-chloro-6-nitro-ortho-amidophenol. The following typical example will serve to further illustrate this new process: The furs are first treated with an aqueous solution of potassium bichromate (2 grms. per liter) and cream-of-tartar (1 grm. per liter). After lying in this solution for twelve hours the furs are removed, rinsed, hydro-extracted, and then introduced into an aqueous solution containing ⅛ to 2 grms. per liter of ortho-amidophenol according to the shade desired. To the latter solution may preferably be added small quantities of peroxide of hydrogen solution and of ammonia. In this bath

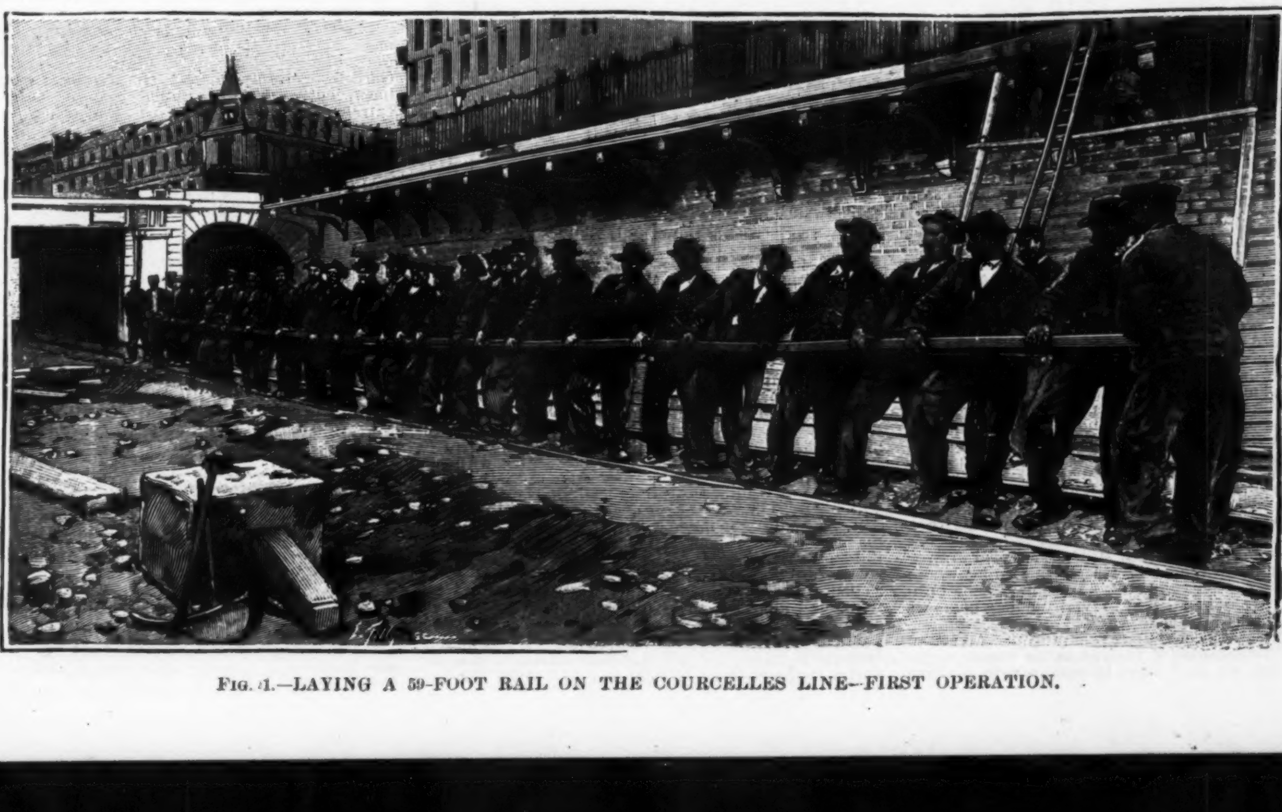


FIG. 1.—LAYING A 59-FOOT RAIL ON THE COURCELLES LINE—FIRST OPERATION.

the goods are allowed to lie for several hours, whereupon they are well rinsed and then finished in the usual manner.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

A German Expert View of the American Iron and Steel Industries.—The German press, which, for the most part, has until recently regarded with more or less suspicion the purposes and probable results of the commercial exposition at Philadelphia, and applauded the reply of Herr Commercienrath Julius van der Zypen, of Cologne, declining his invitation, has changed front very noticeably since the reports have been received describing the opening ceremonies, the nature and scope of the exposition itself, and especially the cordial and hospitable welcome that was accorded to the German delegates and the wish which was generally expressed that a better understanding might be reached on certain technical questions which relate to trade conditions between the two countries, says Consul-General Frank H. Mason.

It is now generally recognized that the Philadelphia exposition has been a most valuable object lesson for merchants and manufacturers of all countries; that it has been organized and managed on broad, liberal principles; and that it would have been a serious error if Germany had followed the lead of its reactionary press and refused to participate in an event from which the general cause of international commerce is certain to derive such important and lasting advantage. The weight of newspaper opinion already favors the creation of a commercial museum for Germany, organized and managed on the same lines as the institution in Philadelphia, which has within so brief a period accomplished such important results.

Not less eagerly read and discussed are the private letters and unofficial reports of the German delegates, who, since the first week of the exposition, have traveled over the United States, visiting shipyards, shoe factories, iron and steel works, and other important industrial establishments. Their correspondence indicates that they have been everywhere cordially received, shown through everything that they wished to see; and, being for the most part scientific experts in the industries which they have examined, they have grasped accurately and promptly the full meaning of all that they have seen.

Among numerous examples of similar correspondence that have appeared recently in the German press, there is selected for translation a report of an interview with the director of a leading German steel plant, which, as published in the Berliner Tageblatt of November 2, discourses as follows on the iron and steel industries of the United States:

"Being asked next concerning the significance that the Commercial Museum exposition in Philadelphia bears from a German standpoint, the director stated that it had by no means the anticipated one-sided character of a source of information for Americans only, but was of equal interest to foreigners. Concerning the industrial situation in the United States, the impression derived by a foreigner is that the present remarkably favorable conditions are solid, legitimate, and likely to be permanent. This is particularly true of the mining and metal industries. An important element in the present unparalleled prosperity of these interests in America is the strong, steady, continuous demand for metals, particularly those used in electrical machinery and installations. It is also true that America far surpasses us in the use of iron and steel for building purposes.

"It is undeniable that the American iron works operate under decidedly more favorable conditions of production than our own. An important factor in these conditions is the fact that the United States possesses far richer and more widely distributed iron ore deposits than Germany. While we are largely dependent upon imported ores—especially Swedish—the American iron works find their raw material at home. To this must be added the other important advantage, that the construction and equipment of their iron and steel works far excel those of Germany and every other European country. In America, we find what seems to us an astonishing substitution of machinery for manual labor. Only in the most necessary details is hand labor now employed. Such a vast and skillful application of machinery offers especial advantage in a time like this, when manual labor is costly and difficult to obtain.

"Finally comes the enormous advantage which the Americans enjoy through the high development of their railway system. The industries have at their command a railway system which far surpasses in cheapness and efficiency of service anything known in Europe. The first sight of the tracks and equipment of an American railroad makes upon a German an imposing impression. Their freight cars of all classes far surpass in size and carrying capacity those of the German railways. Their track system is relatively broader and stronger than ours. Special tracks for freight trains secure rapid, almost unbroken traffic. A widely developed system of branch and side railways (feeders) sustains the traffic of the principal lines. The rates for freight are excessively low. While on the German railways the cost of freight per ton kilometer is (excepting some unimportant special tariffs) 2·2 pfennigs, in America the corresponding rate is only 0·6 pfennig per ton kilometer.

"Under these conditions, the German iron industry finds in that of the United States its greatest, most important, and most dangerous competitor. Just at present, the full force of this competition is not apparent because there is an enormous home demand for iron and steel in America. Several shipments of American foundry pig iron to Germany prove, however, that we have in future to reckon with the competition of American metal here at home. These shipments were ordered by German consumers of pig iron because they were in urgent need of raw material. The belief that the competition of the American iron industry is not yet to be seriously feared may still be cherished in spite of the great development of trusts, concerning whose productive capacity many large figures have been published which it is impossible to verify and which are probably exaggerated.

"But where once a relapse occurs in the American market or a weakening of demand in the world's metal markets, then we shall have to reckon with a sharp and powerful competition from America, especially in heavy plates, structural steel and iron, and rails, for the production of all these in the United States is on an enormous scale. Above all is this true in respect to rails, the production of which is developed to an astounding degree. Works which produce only one type of rails are not uncommon."

To the question, How can the German market protect itself against the future competition of America? the following answer was given:

"The German iron and steel works must follow the American example, and by a greatly enlarged use of machinery reduce the cost of production and protect themselves from future contingencies in the labor market. There is also urgently required for our industry much lower freight rates and the construction of special lines and extra tracks for freight traffic. In this respect, also, America is a model and example for us to follow. The construction of canals, which will offer a cheaper method of transportation, can indeed be of advantage, but can only be considered a palliative, not a remedy."

Samples of United States Goods at Nice.—For many years, thousands of printed circulars and catalogues have been sent to this city, with no practical results, says Vice-Consul Attilio Piatti, of Nice. This indicates that, if the very favorable conditions existing in this part of France for the creation and development of an export trade are to be taken advantage of in the interest of our manufactures, it could be done only by an individual firm which would be willing (a) to deal exclusively in United States products; (b) to submit for a time to hard work with little or no remuneration; and (c) to be prepared to expend a considerable sum in advertising, printing, exhibiting, and traveling.

Having mentioned my plans to a commission merchant here, who, together with two other men speaking the languages and dialects of the Rivieras, appeared prepared to take up the matter seriously, it was resolved to make the attempt in the following form:

A shop of considerable dimensions and centrally located was taken for the purpose of exhibiting samples from American manufacturers at a nominal cost. The plan of action was to examine all catalogues, discarding such as described articles that could not possibly find a market here; and, in case of those that presented a greater or less chance of success, to ask the manufacturer to send a small sample for exhibition. Finally, to work up a trade in each article without loss of time, and where, for special reasons, success could not be attained, to dispose of the sample sent at the best possible figure and to remit the proceeds to the sender.

In order to further encourage these people to successful action, I agreed to supervise the operations of the concern and to aid it by every means in my power. They have now been at work for nine months, and have not succeeded in obtaining a single sample for exhibition. The replies are: "We do not wish to consign; we wish to sell," and the concern has on hand hundreds of catalogues of articles in which there are strong probabilities of trade. I can well understand that United States manufacturers do not wish to send consignments to an unknown market, nor should they. On the other hand, goods can hardly be sold for cash simply from a cut or design. The sending of a single sample to a concern prepared to do all the exhibiting and pushing, having all the elements to achieve success wherever success is possible, would not constitute a "consignment," and would appear to me to be by far the most economical plan for opening up trade in new territories. In view of the lack of success, the concern had decided to give up their present large quarters; but I am so convinced that once a beginning is made, very considerable success may be attained, that I have offered them out of my own pocket the equivalent of six months' rent to induce them to continue their efforts.

Bicycle Trade in England.—The present absence of a good yet cheap English machine makes any comparison with American machines of that class rather doubtful, says Consul S. C. McFarland, of Nottingham. The American youth buys a wheel for from $35 to $50, uses it one or two seasons, and then buys a better one, with intervening improvements, for about the same price. The English lad pays from $80 to $100 for substantially the same machine, but he expects—and his family expects—it to last a lifetime. The first-class American wheel of $100 grade would be worth here about $120. The highest grade English wheel can now be bought for £18 ($90); the free wheel and powerful Bowden rear-rim brake attachment, £20 ($100). Next season, however, the English market will be flooded with a cheap grade machine costing £10 ($50). This will be really the first English experiment at making a substantial machine for a popular selling price. The Coventry and Raleigh and Humber samples stand inspection very well, and would grade from $35 to $50 on the American market. They are lighter than the usual style English machine, and are not so carefully finished, and the material is not first class; but they sell well. They are practically an imitation of the American wheel designed for quick market purposes.

In true adjustment of parts and careful finish, English high-grade wheels are said to excel the American. Each machine is a special product, turned out with infinite care. No work is rushed wholesale through the shop. To build an ordinary machine to order requires, at the least, ten days, while a really fine machine will not be built for delivery short of three weeks. In each case, the bearings are tested and such careful attention given to details of finish as only a British or German workman can afford to give, for his time does not count for much; yet any American machine, even if it be superior in style, to compete successfully with his product, must approach that perfection of finish. The Raleigh and Humber certainly lead the market here, while they failed to secure a substantial foothold in America; and the makers claim they can not make a machine to sell at American prices. The obvious deduction is that American makers should be able to sell successfully here. The English machine weighs 27 to 30 pounds stripped, and runs up from 29 to 35 pounds with mud guards, brake, lamp, etc. The frame is of solid material, and the parts are cast heavier all over, particularly the hub and fork crown. Durability is thought to be secured, but the result admits of dispute and is at the expense of lightness and style. At the same time, those manufacturers who are figuring upon the English market should consider that the public here has been educated to a heavy wheel and views with suspicion the light machine—and British stubbornness, in this connection, is a very stubborn thing.

That there is an enormous market in provincial England for a substantial-looking and worthy machine of good finish that can be retailed from $45 to $55 goes without saying; but the campaign for its successful introduction and sale must be carefully engineered and advertising made judicious and constant, while the peculiar prejudices of the people and English business methods must be consulted at every turn. A competent management in every local field is essential. These are not the conclusions of a bicycle expert, but of an ordinary observer who has given attention to the matter in the hope of being of some service to American manufacturers.

American Bicycles in Switzerland.—The progress which American manufacturers of bicycles have made in the past four years in their trade with Switzerland is remarkable, says Consul Henry H. Morgan, consul at Aarau. It is not possible to say with any degree of accuracy what number of American bicycles were imported into Switzerland during the period named, as the official statistics can not be relied on, for the reason that all bicycles of American manufacture which were sent to Switzerland from any of the distributing points of either Germany or France were credited as an import from the country from which they last came. Thus, a shipment of American wheels to Switzerland from Hamburg is credited by the custom house as a German exportation. The official statistics, however, show the direct importation from the United States, and the strides we have made in this Republic during the past four years.

The year about to end will show a considerable increase over 1898.

The total number of wheels imported into the country during 1898 was 15,027, against 11,067 for the corresponding period of 1897. Of this number, Germany sent 7,531; France, 3,591; England, 773; Belgium, 293; Italy, 286; Austria, 333; and the United States, 2,194.

The average declared value of each wheel was as follows: German, $42.70; French, $42.65; English, $50.65; Belgian, $65.30; Italian, $44.60; Austrian, $46.15; and the American, $42.16.

It will be seen that in point of price, the American wheel stands at the end of the list. In respect to endurance and style, it is admittedly at the head.

I would suggest that a live agent who speaks French and German be sent to canvass the country. He will do more in a short time than catalogues will ever accomplish.

Advice to Exporters.—Consul-General Guenther writes from Frankfort, October 19, 1899:

Kuhlow's German Trade Review and Exporter of October 18, 1899, published at Berlin, contains the following article, "Color versus business," which should receive the attention of American manufacturers of cloth, sewing needles, and leather goods, who sell to the countries named. It illustrates how important it is to study the tastes of the people to whom one wishes to sell, not only as to shape of the articles, but also as to color. It is by paying close attention to the study of special tastes that Germany has made such headway in gaining foreign markets. Let our people do the same, and the results will speak for themselves.

COLOR VERSUS BUSINESS.

It has been recently stated that Germany has captured much British trade in Russian markets simply by catering to the popular taste for red in wearing apparel. English sewing needles have also been ousted in Brazil because they were wrapped in the old-fashioned black paper. The manufacturers of Saxony went in for pink, and hold the market. A French exporter of high-class leather goods has just discovered the Heathen Chinee's antipathy to green by the nonsale of his elegant articles made up in that color. Moral: Leave color fancies for the drawing room, and make money from the rainbow if the market requires it.

Advance Sheets of German Consular Reports.—Vice-Consul-General Hanauer, of Frankfort, on November 15, 1899, writes:

To satisfy the numerous demands from German manufacturers, exporters, and chambers of commerce for an improvement in the information service of the German consular bureau, the Imperial government has recently begun to publish pamphlets containing extracts from consular reports and other interesting matter. The new publication is prepared by the Imperial Ministry of the Interior and bears the title "Advices for Commerce and Industry." It is something between our Advance Sheets and Monthly Consular Reports. The latest issue of this publication contains an article headed "Hints for merchandise exports to the United States," which advises manufacturers to state weights, measures, and prices in American standards; to strictly observe the United States customs regulations regarding the marking and classifying of goods and packing; to endeavor to introduce articles not only in the large cities, but in the medium-sized and small places; to try to please the varying tastes of the American people, etc.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Testing Linseed Oil.—A simple and cheap method is the nitric acid test. Pour equal parts of linseed oil and nitric acid into a flask, shake vigorously and let it stand for twenty minutes. If the oil is pure, the upper stratum is of straw yellow color and the lower one colorless. If impure, the former is dark brown or black, the latter pale orange or dark yellow according to the admixtures to the oil.—Farben Zeitung.

Celluloid or Zapon Varnish.—For the production of the well-known zapon or celluloid varnish, Buchheister gives the following tried recipe, founded on his own experiments: Pour 20 parts of acetone over 2 parts of colorless celluloid waste, leaving it stand for several days in a closed vessel, stirring frequently until the whole has dissolved into a clear, thick mass. Now admix 78 parts of amyl acetate and clarify the zapon varnish by leaving it settle for weeks.—Pharmaceutische Centralhalle.

Preventing the Peeling of Coatings for Iron.—To obviate the scaling of coatings on iron, if exposed to the attacks of the weather, it is advisable to wash the iron thoroughly and to paint it next with a layer of boiling linseed oil. If thus treated, the paint never cracks off. If the iron objects have only small dimensions and can be heated, it is advantageous to heat them previously and to dip them completely into linseed oil. The boiling oil enters all the pores of the metal and drives out the moisture. The coating adheres so firmly that neither frost, rain, nor wind can injure it.—Neueste Erfindungen und Erfahrungen.

Deodorization of Calcium Carbide.—Calcium carbide is known to possess a very unpleasant odor because it constantly develops small quantities of impure acetylene in contact with the moisture of the air. Le Roy, of Rouen, proposes for portable—especially bicycle—lamps, in which the evil is more sensible than in large plants, to simply pour some petroleum over the carbide and to pour off the remainder not absorbed. The petroleum, to which it is well to add some nitro-benzol (mirbane essence), prevents the access of air to the carbide, but permits a very satisfactory generation of gas on admission of water.—Neueste Erfindungen und Erfahrungen.

To Remove Musty Taste and Smell from Wine.—For the removal of this unpleasant quality, Kulisch recommends the use of a piece of charcoal of about the size of a hazel nut—500 to 1,000 grammes per 1,000 liters of wine. After same has remained in the cask for six to eight weeks, and during this time has been treated once a week with a chain or with a stirring rod, the wine can be racked off. In the case of a very mouldy claret, the side taste was removed, the color had not suffered perceptibly, the bouquet was unimpaired. Obstinate turbidness, as well as stalk taste and pot flavor, can also be obviated by the use of the said remedy.—Centralblatt für Bacteriologie.

Fireproofing Wood.—The Moniteur Industrielle reports that the English Admiralty has rendered the wood of its vessels highly sensitive to heat and fire in the following manner. It only ignites in extreme cases and burns with a small flame, but is impervious to flames leaping over it. Prepare a sirupy solution of sodium silicate 1 part and water 3 parts and coat the wood 2 to 3 times, thus imparting to it great hardness. After drying, it is given a coating of lime of the consistency of milk, and when this is almost dry, is fixed by a strong solution of soluble glass, 2 parts of the sirupy mass to 3 parts of water. If the lime is applied thick, repeat the treatment with the soluble glass.

Preservative for Shoe Soles.—This preparation, destined for impregnating leather shoe soles, is produced as follows: Grind 50 parts of linseed oil with 1 part of litharge; next heat for two hours to 100° C. with ¼ part of zinc vitriol, which is previously calcined (dehydrated). The composition obtained in this manner, when perfectly cold, is mixed with 8 parts of benzine and filled in bottles or other receptacles. To render this preservative effective, the soles must be coated with it until the leather absorbs it. The advantages of this medium consist in that moisture cannot penetrate through the shoe soles, which at the same time are rendered much more durable.—Seifensieder Zeitung.

Formaldehyde for Disinfecting Books, Papers, etc.—S. N. Milewski recommends formaldehyde for this purpose. The property of formaldehyde to penetrate all kinds of paper, even when folded together in several layers, may be utilized for a perfect disinfection of books and letters, especially at a temperature of 30°-50° C. in a closed room. The degree of penetration as well as the disinfecting power of the formaldehyde depend upon the method of generating the gas, by an autoclave of Trillat or a Schering lamp. Letters, paper in closed envelopes, are only completely disinfected in 12 hours, books in 24 hours at a temperature of 50° C. when 70 c. cm. of formochloral—17·5 g. of gas—per cubic meter of space are used. Books must be stood up in such a manner that the gas can enter from the sides. Bacilli of typhoid preserve their vitality longer upon unsized paper and on filtering paper than on other varieties of paper.—Neueste Erfindungen and Erf.

Harness Grease in Cans.—This harness grease is applied by means of a rag and brushed.

Ingredients—

1.	Ceresine, natural yellow	2·5 kilos.
	Beeswax, yellow	0·8 "
	French colophony, pale	0·4 "
2.	French oil turpentine	2·0 "
	Intimately mixed in the cold with American lamp black	1·5 "

Put mixture 1 in a kettle and melt over a fire. Remove from the fire and stir in mixture 2 in small portions. Then pour through a fine sieve into a second vessel, and continue pouring from one kettle into the other until the mass is rather thickish. Next fill in cans.

Should the mixture have become too cold during the filling of the cans, the vessel containing the grease need only be placed in hot water, whereby the contents are rendered liquid again, so that pouring out is practicable. For perfuming, use cinnamon oil as required.—Neueste Erfindungen und Erfahrungen.

MISCELLANEOUS NOTES.

Before the Russian Chemical Society, according to Science, a new cerium mineral from the Caucasus has been described by G. Tschernik, which from the analysis seems to be essentially a titanate and zirconate of cerium. It contains a gas which is 90 per cent. a mixture of nitrogen and argon. The mineral contains but 0·03 per cent. uranium and no helium. The ash of a coal from Tkwibuli, which was chiefly calcium sulphate, with alumina and silica, and about 10 per cent. of ceria, lanthana, and didymia, showed the presence of over 1 per cent. of helium.

An instance of the use of liquid ammonia as a solvent is shown by C. Hugot, says Science, where the selenides of sodium and potassium are thus formed. A mixture of selenium with the alkali metal is treated with liquid ammonia. If the metal is in excess the insoluble selenide Na_2Se or K_2Se is formed, while if the selenium predominates a polyselenide Na_2Se_4 or K_2Se_4 is formed, which is dissolved in the ammonia and is obtained on its evaporation. Contrary to the observation of Franklin and Krauss, Hugot finds that selenium itself is insoluble in liquid ammonia.

A cord of spruce wood, Prof. G. H. Prescott estimates, is equal to 615 feet board measure, and this quantity of raw material will make half a ton of sulphite pulp, or one ton of ground wood pulp. Newspaper stock is made up with 20 per cent. of sulphite pulp and 80 per cent. of ground wood pulp. The best known spruce land, virgin growth, possesses a stand of about 7,000 feet to the acre. Twenty-two acres of this best spruce land will therefore contain 154,000 feet of timber. An average gang of loggers will cut this in about eight days. This entire quantity of wood turned in at any one of the large mills will be converted in a single day into about 250 tons of such pulp as goes to make up newspaper stock. This pulp will make about an equal weight of paper, which will supply a single large metropolitan newspaper just two days, so that newspapers as well as builders have a practical interest in forestry.—Popular Science.

Consul Diederich, at Magdeburg, has transmitted to the State Department the estimates of five of the leading European authorities on this year's beet sugar crops. About three-fourths of the world's supply of sugar is made from the sugar beet, therefore the statistics we quote are of particular interest alike to makers and consumers. The crop, according to these authorities, will range in quantity from 4,933,693 to 5,445,000 metric tons. It is, however, to be noted that Consul Diederich expresses a preference for the former estimate. The crop of the season 1898-99 amounted to 4,947,892 metric tons. It should be explained that the metric ton used in these estimates contains 2,204·6 pounds. Figures show that the yield of beets per acre has been larger than that of last year, but the contents of sugar in the beet have been less, France showing the largest decrease in this respect. Taking the yield of cane sugar this year at 2,700,000 metric tons, a grand total of the world's production of sugar will bring it about 8,000,000 tons.

Iodine is found in many quarters where it would least be suspected. According to some interesting experiments of Armand Gautier, we are told in La Science Illustrée, the thyroid gland contains about one-thousandth part, by weight, of this substance. Where does it come from? Some authorities say that it is derived from the atmosphere or from water, but others fail to discover traces of the substance therein. M. Gautier believes, however, that their failure was due to insufficient methods. He finds minute quantities of iodine in the air of Paris, and still more in that of the seashore and salt marshes. It is well known that seaweed is especially rich in iodine. It has also been discovered in ordinary foods, especially in certain fish. By bathing a rabbit in water containing iodine, M. Gallard discovered a curious fact, namely, that the brain has a peculiar attraction for this substance, absorbing over seven times as much, proportionately to weight, as the glands of the neck and four times as much as the heart and lungs. Iodine may have a special action on the brain, but this is for future experiments to determine.

The level of Great Salt Lake is steadily falling on account of the large volume of water tributary to it which is now absorbed by irrigation enterprises. The disappearance of the lake would take from the neighborhood of Salt Lake City one of its chief attractions, but would make easily accessible one of the greatest sources of salt in the world. Conservative calculations of scientific men estimate that the waters hold about 400,000,000 tons of common salt. Accepting this estimate as approximately accurate, every other source of salt pales in comparison with the riches Great Salt Lake will offer if its waters disappear, leaving the mineral more easily and cheaply accessible, as it will be, than in any other salt mines or evaporation grounds of the world. The United States produced last year 2,450,000 tons of salt. If all the saltmakers of the country should go to the dried-up bed of Great Salt Lake it would take them, at last year's rate of production, more than 163 years to exhaust the supply. The great salt centers of New York, Michigan and Kansas might be held as a reserve for the sixth or seventh generation to come.

At a recent meeting of the Academy of Sciences, M. Louis Boutan, who is connected with the Arago laboratory at Banyuls on the sea coast, presented a series of instantaneous submarine photographs, taken with a camera 18 × 24 centimeters, having an anastigmatic objective and arranged to be operated under water. These plates have been obtained on a clear day when the sun was high in the horizon, and the results are very good; in several plates are clearly perceived bands of fish which have been taken at a distance of 1·50 to 2 meters from the objective, the camera being immersed to a depth of 3 meters. In order to form a background, a white screen was let down, before which bait was thrown in order to attract the fish into the field of the camera. This, however, is not indispensable, as on certain of the plates the fish are easily distinguished against the sandy bottom, and a diver placed against a background of seaweed, at a depth of 3 meters and a distance of 4 meters from the camera, gave a very good image. M. Boutan estimates that it is possible to take good instantaneous plates at a depth of 7 to 8 meters when the weather is favorable.

SELECTED FORMULÆ.

Masking Odor of Kerosene.—Various processes have been recommended for masking the odor of kerosene, such as the addition of various essential oils, artificial oil of myrbane, etc., but none of them seems entirely satisfactory. The addition of amyl acetate in the proportion of 10 grammes to the liter (1 per cent.) has also been suggested, several experimenters reporting very successful results therefrom. Some years ago Beringer proposed a process for removing sulphur compounds from benzine, which would presumably be equally applicable to kerosene. This process is as follows:

Potassium permanganate	1 ounce
Sulphuric acid	½ pint
Water	3½ pints

Mix the acid and water, and when the mixture has become cold pour it into a two-gallon bottle. Add the permanganate and agitate until it is dissolved. Then add benzine 1 gallon, and thoroughly agitate. Allow the liquids to remain in contact for twenty-four hours, frequently agitating the mixture. Separate the benzine and wash in a similar bottle with a mixture of:

Potassium permanganate	¼ ounce
Caustic soda	½ "
Water	2 pints

Agitate the mixture frequently during several hours; then separate the benzine and wash it thoroughly with water. On agitating the benzine with the acid permanganate solution an emulsion-like mixture is produced, which separates in a few seconds, the permanganate slowly subsiding and showing considerable reduction. In the above process it is quite probable that the time specified (24 hours) is greatly in excess of what is necessary, as the reduction takes place almost entirely in a very short time. It has also been suggested that if the process were adopted on a manufacturing scale, with mechanical agitation, the time could be reduced to an hour or two.

Patent Leather Polish.—To restore patent leather to its original appearance after it has lost its fine gloss or become cracked is a task which, we think, cannot be satisfactorily accomplished. Attempts made in this direction have resulted in the formulation of the following recipes:

1.	Yellow wax	6 drs.
	Olive oil	2 ozs.
	Oil of turpentine	½ oz.
	Oil of lavender	½ oz.

Melt the wax and olive oil together, add the turpentine, and when nearly cool the oil of lavender. This is said to restore the flexibility of patent leather which has become hardened and to renew its gloss to a certain extent.

2.	Yellow wax (or ceresin)	3 ozs.
	Spermaceti	1 oz.
	Turpentine oil	11 ozs.
	Asphaltum varnish	1 oz.
	Borax	80 grs.
	Frankfort black	1 oz.
	Prussian blue	⅜ oz.

Melt the wax and stir well with the borax; melt the spermaceti separately, adding to it the turpentine in which has previously been dissolved the varnish; stir the second mixture into the wax and add the colors.

As a coloring matter where the leather has been scratched the following may be of service, applied, of course, before the polish:

Gum arabic	4 ozs.
Molasses	1 oz.
Nutgall ink	8 ozs.
Vinegar	½ oz.
Sweet oil	½ oz.
Alcohol	1 oz.
Lampblack	1 dr.

—Druggist's Circular.

A Good Liquid Glue.—Take of—

Sugar of lead	1½ drachms.
Alum	1½ "
Gum arabic	2½ "
Wheat flour	1 av. lb.
Water	q. s.

Dissolve the gum in 2 quarts of warm water; when cold mix in the flour, and add the sugar of lead and alum dissolved in water; heat the whole over a slow fire until it shows signs of ebullition. Let it cool, and add enough gum water to bring it to the proper consistency.—National Druggist.

Mending Platinum Vessels.—Frank James says in The National Druggist that he has frequently succeeded, in mending small holes in platinum capsules by placing a small crystal of gold chloride over the aperture, and attaching it by melting with a gentle heat, and then turning on the flame of the oxyhydrogen blow-pipe, by which the chloride was reduced, filling the hole with a plug of pure gold. For larger holes, after cleansing the bottom around the hole, he cuts a disk of platinum foil a little larger than the aperture; with a glass rod touches the edge around the aperture with a solution of the chloride, warms gently, until the moisture has been driven off, approximates the foil over the opening, and turns on the oxyhydrogen flame as before. The gold acts as a solder between the platinum surfaces, and makes the capsule as good as ever, he says, for all purposes which do not require an extreme heat.

Soap for Cleaning Surgical Instruments.—A soap for cleaning surgical instruments, and other articles of polished steel, which have become flecked with rust by exposure in show case, is made (Month. Mag. Pharm.) by adding precipitated chalk to a strong solution of cyanide of potassium in water, until a cream-like paste is obtained. Add to this white Castile soap, in fine shavings, and rub the whole together in a mortar, until thoroughly incorporated. The article to be cleaned should be first immersed, if possible, in a solution of one part of cyanide of potash in four parts of water, and kept there until the surface dirt and rust disappears. It should then be polished, with the soap, made as above directed.

A COMPARATIVE STUDY OF THE PHYSICAL STRUCTURE OF THE LABRADOR ESKIMOS AND THE NEW ENGLAND INDIANS.*

PRIOR to 1660, the Eskimos on the peninsula of Labrador were distributed along the Hudson Bay and the Atlantic coasts, and reached as far as Mingan on the Gulf of St. Lawrence. At that time the Indians received firearms from the French and drove back the Eskimos as far as the Straits of Belle Isle; while at the present time they do not extend beyond Hamilton Inlet. From there we now find Eskimos all along the coast around to the mouth of Great Whale River, and some of them are coming southward to the islands in James Bay, according to the reports of Mr. Low, of the Canadian Geographical Survey.

FIGS. 1 AND 2.—INDIAN AND ESKIMO CRANIA, WITH AVERAGE INDICES.

Such has been the distribution of the Eskimos in post-Columbian times. We are told by several authorities who have investigated the arts and customs of these people that the Eskimos formerly occupied the Atlantic coast for some distance within the territory now embraced by the United States; at all events, they overran the New England territory, which, at the time of the arrival of the whites, was occupied by the Algonkian Indians.

It is an interesting problem to know to what extent intermixture has taken place between the Algonkians and these Eskimos of the Labrador peninsula or the northeastern part of the continent. It has become the fashion to say that mixture has taken place between races everywhere; that it is a problem of purity; not a direct problem as to whether or not the two races are mixed, but as to how much they are mixed. We are told that the Eskimos and Indians have undoubtedly mingled their blood in Labrador and New England; and the Eskimos that we now know in Labrador are not typical representatives of the race. We must look to Greenland and the northern islands for the pure strain of Eskimos. For that reason we have undertaken in this investigation to determine to what extent the mixture has taken place, if mixture there be; to determine the physical type of the Labrador Eskimos; and to try to discover to what extent this will shed light upon the problem of their origin as a race. Did they come from that region around Hudson's Bay, as suggested by Boas; or, did they originate in Alaska, as Rink maintained?

Only a portion of these problems can be touched upon in the brief time at my disposal. Dry bones are pretty dry things to deal with; but we shall try to show that they are not uninteresting to the somatologist, at least. A. C. Haddon, in his "Study of Man," says: "There certainly is a wonderful fascination in

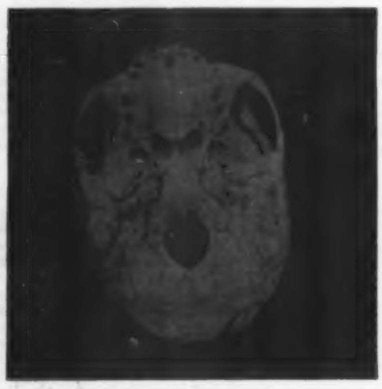


FIG. 7.—SPINE PROJECTING INTO FORAMEN MAGNUM.

skulls; and craniology, which to the outside observer appears to be about as uninteresting a subject as could well be conceived, has lured its votaries to more and more persistent and painstaking effort. The present writer, who once sat in the seat of the scornful, has also yielded to the charm of craniology."

Every investigator who has taken up the study of craniology or osteology, the deeper he gets into the subject, the more enthusiastic supporter of the science he becomes.

The material with which we have had to deal was somewhat meager, with respect to the Eskimos, at least; while the number of Indian skeletons was, so far as our ability to measure was concerned, practically unlimited. I shall deal with the cranium before taking up the long bones. I selected thirty-three from a collection of forty-four skulls from the peninsula of Labrador, and compared these with two hundred or more Indian crania. Some 735 long bones were measured by my colleague, Mr. Henry Minor Huxley. Heretofore ten Labrador skulls have been described, beginning with those in the "Decades" of Blumenbach. Ten skulls form a very small series from which to establish the cranial type of a race; furthermore, even these published results have not been correlated. From 260 to 300 Greenland crania have been described;

FIGS. 3 AND 4.—WELL MARKED ESKIMO AND INDIAN OUTLINES.

and the physical structure of these people is well known.

Viewed from above, the crania of the Labrador Eskimos vary in outline from an elongated pentagon to a narrow ellipse. A Labrador skull having the average cranial index of the whole series is depicted in Fig. 2; while Fig. 1 represents the New England skull with the average cephalic index of the Algonkian series. The general outline only is to be noted in this case. They were photographed together, on the same scale, and represent the average cephalic index, but not necessarily the average in size. The general outline of the two skulls is distinctly different.

In Table A the average cranial indices of the

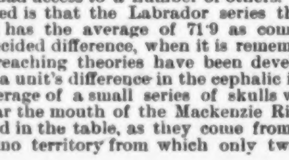
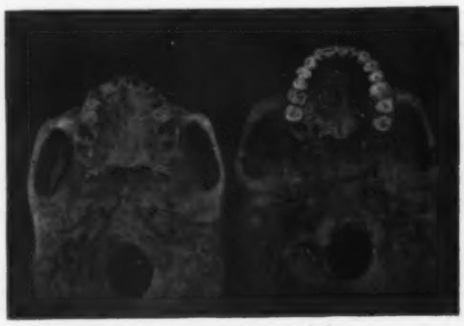


TABLE A.—INFRA-ORBITAL SUTURE.

groups studied are shown, and those in brackets are introduced for purposes of comparison. It will be noted that the indices range from 71 in the Greenland skulls down to 75 and 76 in the New England groups—averages determined by Mr. Carr, formerly of the Peabody Museum, who used a portion of the same skulls that I have measured in determining this average, but had access to a number of others. The point to be noted is that the Labrador series that I have measured has the average of 71·9 as compared with 74·6—a decided difference, when it is remembered that very far-reaching theories have been developed from tenths of a unit's difference in the cephalic index.

The average of a small series of skulls which I collected near the mouth of the Mackenzie River in 1894 is included in the table, as they come from a part of the Eskimo territory from which only two or three



FIGS. 8 AND 9.—TYPICAL HARD PALATE OF ESKIMO AND INDIAN.

skulls, I believe, have ever been obtained; and the cephalic index, which is exactly the same as the Algonkian Indians, is very suggestive. We should expect that these New England crania would have an index nearly like that of the Labrador crania, rather than that it should resemble that of the Herschel Islands, or Mackenzie River, Eskimos, who lived three thousand miles northwest from these Labrador people.

Figs. 3 (Eskimo) and 4 (Indian) represent the extreme forms, the outlines which we commonly would recognize anywhere as belonging to these groups. The one is not so easily identified as an Indian skull, but is still a strong, well-marked male skull of the Algonkian group. The narrow and long shape of the Eskimo skull is well shown.

The temporal crest is not strongly marked on the Labrador crania, and the bi-stephanic breadth cannot be determined accurately upon them. The lines on the prominent occiput are not pronounced, and the inion is not well defined in most cases; while in the Indian skulls these lines are well defined, and the projection at the back of the skull is quite large. Nothing need be said of the Wormian bones that occur in the sutures of the Eskimo skulls except that the percentage of occurrence of the Wormian bones is exactly that given by Anutchin for the Mongols. Among the Indians the proportion of crania possessing this anomaly is three times as great; and the significance of this is evident in the comparison of the various peoples of the world. A series of thirty-three skulls is altogether too small for this percentage to possess any considerable value; yet as far as it goes it points toward the relationship of the Eskimos with the Mongols, rather than with the Indian. The variations of the sutures of the face are susceptible of statistical treatment and are characteristic of racial or, it may be, of culture groups.

FIGS. 5 AND 6.—LATERAL VIEW OF INDIAN AND ESKIMO SKULLS.

The Labrador Eskimos are broader in the posterior portion of the skull in proportion to the total width than are the New England Indians, in males; while the reverse is true in the females. In bi-auricular breadth the Indians exceed the Eskimos. The widest difference is to be seen in the bi-stephanic breadth, where the high temporal muscles of the males in the Eskimos brings this down to 56; while among the Indians this is less marked in the female groups. In the inter-pterion and frontal breadths the Eskimos exceed the Indians; in fact, in nearly all breadths, the proportion is greater in the former group.

Figs. 5 (Indian) and 6 (Eskimo) represent lateral views of the same skulls shown in the last figures. Note the projecting glabella, the projecting nose and the character of the jaw of the Indian. Compare the Eskimo's cranium, with smooth forehead and flat nose. (See Table A.)

The percentage of occurrence of the infra-orbital suture may be represented graphically. The line extending to the extreme right represents the percentage of occurrence; while the percentage in which this anomaly is wanting is represented by the line as far as the first intersecting bar. It is wanting in a far greater percentage of Indian than in Eskimo crania. In the Labrador group it is present in 79 per cent. and wanting in 20 per cent.; New England, present in 56 per cent. and wanting in 43 per cent.

Anutchin has shown that the length of the spheno-parietal suture varies to a considerable extent among the principal groups of mankind. The average length does not interest us particularly; the most interesting part of the table is the percentage of occurrence of pteria measuring less than 8 mm. in length; in the Labrador group 13·7 per cent. are shorter than 8 mm., while in the Indian group only 4·3 per cent., and in a larger number (335) of California crania, the percentage was 14·9 per cent., approximately the same as the Eskimos; so that we find the Eskimos agreeing closely with the California Indians and differing wholly from those of New England. The significance of this will be apparent from the table given by Anutchin. The

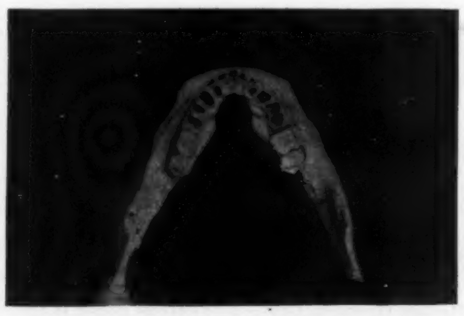


FIG. 10.—ALVEOLAR HYPEROSTOSIS.

only Indians measured by him had the percentage of 3·4 per cent. of those possessing the short pteria, while the other races had widely differing percentages.

Fig. 7 represents an interesting anomaly, found in one of the Eskimo crania, where a projection extends backward for six millimeters into the foramen magnum. There is no articulation for the odontoid process of the axis.

In the shape of the hard palate we find a very striking difference between these two groups. Figs. 8 (Eskimo) and 9 (Indian). The Eskimoan palate is very flat; the teeth are wanting, which exaggerates this difference; but as compared with the very deep palate of the Indian there is a marked difference. The posterior nasal spine differs in the two groups very considerably. In general, the shape of the Eskimo's palate is of a lower

* An illustrated lecture by Frank Russell, Ph.D., Instructor; Member of the Faculty of Arts and Sciences, Harvard University. Delivered before the Anthropological Section of the American Association for the Advancement of Science, August 24, 1899, at the Ohio State University, Columbus, O. Revised by the author, especially for the SCIENTIFIC AMERICAN SUPPLEMENT.

type than that of the Indian. It is occasionally U-shaped, which is the type seen among the anthropoid apes; and in general even the casual observer would note that the type of the palate among these Labrador Eskimos is distinctly different from, and "lower" than, that among the Indians.

Fig. 10 represents an anomaly termed by Harrison Allen alveolar hyperostosis—that is, an outgrowth of bone on the inside of the jaw; it is a tumous growth contracting the space between the premolars. This bony outgrowth occurs in 50 per cent. of the collection of Labrador Eskimos and exists in a much less marked degree in 12 per cent. of the New England Indians. It is present in 14·20 per cent. of jaws from the stone graves of Tennessee; while 75 jaws from California show no trace of this anomaly. It is present in a larger percentage of the jaws from the stone graves of Tennessee than it is in the jaws from New England, where we should expect it to occur in the highest percentage of any Indian group, if the New England Indians are closely related to the Labrador Eskimos.

The nasal index is much lower in the Eskimos than in the New England crania. (See Table B.)

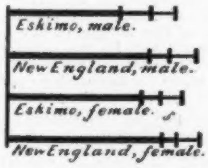


TABLE B.—NASAL INDEX—MINIMUM, AVERAGE, AND MAXIMUM REPRESENTED IN MILLIMETERS.

As this low index is one of the most marked characteristics of the Eskimos, it is interesting to note that those of Labrador have no higher index than those of North Greenland, where mixture with the Indians could not have occurred.

In Figs. 11 (Indians) and 12 (Eskimos) we have typical nasal apertures of the two groups. In the Eskimo skull the narrow nose is somewhat exaggerated by the nasal bones having been broken—the inferior margin

FIGS. 11 AND 12.—TYPICAL INDIAN AND ESKIMO NOSES.

is usually sharp. Note the relative form of orbit in the two skulls.

The minimum, average and maximum orbital index is shown in the diagram. (See Table C.)

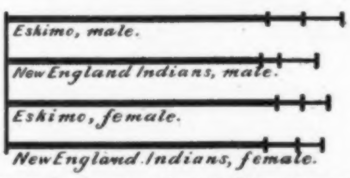


TABLE C.—ORBITAL INDEX, REPRESENTED GRAPHICALLY IN MILLIMETERS.

The orbit of the Eskimo is much rounder, so that the average is extended further to the right in the diagram.

The relative cranial capacity of these two groups is interesting.

In conclusion we may say that in almost every measurement and index, a considerable gap has been found between the Labrador Eskimos and the Indians. The difference is sufficiently marked to warrant us in maintaining that the skeleton contains no evidence of intermixture of these peoples; in fact, the Tennessee Indians resemble the Labrador Eskimos far more closely than do the Algonkian Indians of Massachusetts; and in cranial characters, the New England tribes resemble not the adjoining Eskimos of Labrador, but the distant Eskimos of the Mackenzie region. We have undertaken this study without prejudice; and Mr. Huxley's results were unknown to me and mine unknown to him until we made our final summing up and the work was practically done; so that the evidence thus presented is, so far as we have been able to make it, truthful and agreeing with the facts.

We submit that the physical structure—the skeletal structure—of these Labrador people does not show any considerable intermixture of Indian blood.

CULTIVATION OF INSECT FLOWERS IN ALGERIA.

THE cultivation of the pyrethrum plant for the production of insecticide powder has been attended with encouraging results at the botanical station of Rouïba, in Algeria. Trial cultivations have been made with the white pyrethrum of Dalmatia, a plant that is more vigorous and more prolific in flowers than the Caucasian or the Persian varieties. At the present day, two-thirds of the insect powder obtained from pyrethrum that is used in Europe is produced in Dalmatia. The plant (the exact species is not given in the note) requires a clayey-sandy soil, somewhat light; it can withstand drought. It is right to irrigate only in case of extreme dryness of the soil. In Algeria it is necessary to sow in the nursery from the beginning of autumn, and to transplant in the spring. The plantation is arranged so that the plants form rows one meter apart; each plant is separated from the next by a distance of fifty centimeters. The plant flowers in May, and is harvested in the course of the summer. Six to eight hundredweights of dried flowers are gathered per hectare. The powder is obtained by pounding the flowers in a mortar.—Revue des Cultures Coloniales.

NERINE "MISS WILMOTT."

MR. H. J. ELWES, Colesborne, Andoversford, Gloucestershire, is well qualified to be placed first among the hybridists who are now turning their attention to the improvement of that beautiful class of Amaryllids, the Nerines, fine groups of which he has been in the habit of staging at the winter shows of the Royal Horticultural Society for some years past; each successive year marking the improvement he has made, and especially in the matter of the flowers being produced at the same time as the leaves, a point which Mr. Elwes takes much pains to secure, and thus to avoid the one reproach of the earlier-flowering species of the N. Sarniensis class, which usually are leafless when the flowers are produced. The flowers of "Miss Wilmott" were of a deep, soft scarlet. Others varied from pale pink to scarlet. N. Mrs. Godman being purplish rose, and N. Mrs. Berkeley light orange-red.—We are indebted to The Gardeners' Chronicle for the article and engraving.

NERINE "MISS WILMOTT"—FLOWERS ORANGE-SCARLET.

LIQUID HYDROGEN AND SEED GERMINATION.

SIR W. T. THISELTON DYER has made some experiments, at the instance of Prof. Dewar, on the influence of the temperature of liquid hydrogen on the germinative power of seeds. The seeds formerly selected by Brown and Escombe, when experimenting upon the effect of the temperature of liquid air on seeds, were chosen so as to represent different families. The number they used was too large for the present investigation, on account of the costliness of liquid hydrogen. Barley and wheat were taken for the sake of comparison with Brown and Escombe's results. The question of shape and bulk next influenced the selection; wheat and barley are roughly ellipsoidal and medium in size; the vegetable marrow was added because it is relatively large but flattened, and mustard, which is small and spherical. Composition was next considered, so in addition to these oily and farinaceous seeds a pea was taken, on account of its nitrogenous composition, and partly because of its spherical shape. Lastly, a very minute seed, the musk, was chosen. All the seeds were supplied by Messrs. Sutton, of Reading, and certified of good germination. They were sealed up in a glass tube cooled first in liquid air and then transferred to hydrogen. In this way a temperature of —250° or —252° C. was reached and maintained for half an hour, and later for an hour, another set of seeds being cooled only in liquid air for comparison. On opening the tinfoil packages in which the seeds had been wrapped they were found to be as fresh and bright as before treatment. They were sown in a cool greenhouse, without heat, on July 27. On August 1 they had all germinated. Again a packet of seeds was cooled, this time without graduation of cooling, and actually immersed in liquid hydrogen for upward of six hours. The temperature reached was —453° F. below melting ice. These seeds germinated without exception. Prof. Dewar considers that there is no doubt about the seeds having actually been brought down to the temperature of the liquid hydrogen. It seems probable that plant structures are deficient in thermal transparency, and they are notoriously indifferent conductors. Nevertheless, it is difficult to believe that in the case of such small bodies as seeds, their being brought to the temperature with which they are surrounded can be more than a question of time. It is not impossible, however, that even at low temperatures, the thermal capacity of at least the seed coats may be considerable.—Proceedings of the Royal Society.

EXPERIMENTS WITH MILK PRESERVATIVES.

IN some recent experiments with animals on the physiological action of minute quantities of boric acid and of formalin, as employed as food preservatives, H. E. Annett has thrown considerable light on what is a most important, but, so far, undetermined question. Five kittens were fed on milk containing 80 grains of boric acid per gallon. In four weeks all were dead. Five kittens were fed on milk containing 40 grains per gallon; two died in the third week, and the rest in the fourth. Five control kittens received pure milk, none died. The diminution in weight in the animals receiving the boric acid milk was very marked and brought into significant relief by comparison with the increase in weight in those fed on the normal fluid. It was seen, in a day or two, that the kittens treated with the boric milk were losing appetite. Diarrhœa, inactivity and depression followed, then rapid emaciation and death. With milk containing formalin similar results were obtained. Of five kittens treated with milk containing 1 part formaldehyde in 50,000 of milk, three died in five weeks; the average increase in weight was 177·6 grammes, compared with 251·1 grammes of four control kittens treated with normal milk; with milk containing 1:25,000 of formaldehyde, another series showed an average gain of 196·6 grammes as against 325·7 grammes gain by kittens fed on normal milk. Of a third lot treated with milk containing 1 part of formaldehyde in 12,500 of milk, two died in the fourth week; the average gain in weight was only 96.4 grammes against 312·5 grammes with the "controls" fed on normal milk. The younger the animals were, the more susceptible they appeared to the influence of the formalin. The experiments are only preliminary, but the fact cannot be denied that they have a very distinct bearing on a matter which is, literally, of vital importance.—Lancet.

ATOMIC WEIGHT OF NITROGEN.

G. DEAN gives an account of work in connection with the determination of the atomic weight of nitrogen, in continuation of that of which a preliminary notice has already been communicated (Proc. Chem. Soc., 1898, 14, 174). He deduces from the results of previous workers a mean value of 14·034 for the atomic weight of nitrogen, but points out that the means of the determinations by chemical methods of individual workers vary from 13·975 (Pelouze) to 14·05 (Stas). The ratio of the densities of oxygen and nitrogen, as determined by Lord Rayleigh and by M. Leduc, is 16: 14·003. As those variations seemed to be too great, it was decided to try a new method which would involve as few atomic weights as possible, and only those which are known with the highest accuracy. Silver cyanide was selected as the compound containing nitrogen, and the ratio between a given mass of it and that of the potassium bromide required for the complete precipitation of the silver contained in it determined with all the precautions insisted on in such work by Stas. The cyanide was decomposed in some cases by dissolving it in nitric acid, in other experiments sulphuric acid. The ratio between the purest silver and the sample of potassium bromide used was carefully determined, so that the ratio found

was really Ag : AgCN. This was found to be 107·93 : 133·962, whence CN = 26·032 and N = 14·031 if C = 12·001.—Proceedings of the Chemical Society.

CYCLE CONSTRUCTION AND DESIGN.*

By ARCHIBALD SHARP, A.M. Inst. C.E.

BALL BEARINGS.

THE earliest bearings used in cycle construction were of the plain cylindrical journal type. With the now almost universal adoption of ball bearings for cycles, the general impression among cyclists is that the frictional resistance of the latter is very much less than that of the former. As a matter of fact, if the cylindrical journal bearing can be kept efficiently lubricated there is little to choose between it and a ball bearing when each is carrying a fairly heavy load. It is the question of lubrication that separates the two types and makes the ball bearing far superior for cycles. A cylindrical journal bearing must be lubricated continuously if the best results are to be obtained from it, whereas a ball bearing will run satisfactorily for a long time without any oil supply. At the present day the plain cylindrical bearing is used for the crank-axle in the Collier two-speed gear, and for the spindles of the intermediate pinions of the Crypto front driving gear. In both cases provision is made for efficient lubrication, and the rider of either would never suspect from his actual experience that he had such an old-fashioned contrivance on his machine.

Adjustable Bearings.—The adjustment after wear of a cylindrical bearing is a matter for the mechanic; if the bearing surfaces be made conical, a simple screw adjustment can be used to take up the wear. A conical bearing was much used for the back hub of the ordinary bicycle.

Ball Bearings.—Fig. 1 shows a diagrammatic section of a ball bearing with conical adjustment. Two rows of

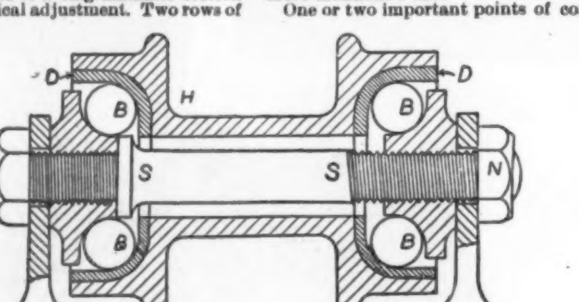


FIG. 1.

balls, B, each run between a pair of hardened steel ball paths, one fixed to the spindle, and one to the barrel. One of the cones is screwed up hard against a shoulder on the spindle, while the other is screwed until both rows of balls are lightly pressed between their paths, and no perceptible shake is left. The adjusting cone is locked in position by the lock nut, N.

There are three kinds of motion at the point or surface of contact of two bodies having relative motion, viz., rubbing, rolling, and spinning. In ball bearings these three motions exist simultaneously, although it is a popular belief that only rolling motion exists. Two adjacent balls rub on each other; but the mutual pressure between the balls is very little. Fig. 2 is in-

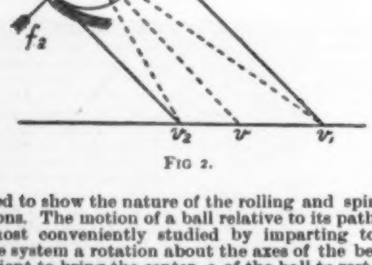


FIG 2.

tended to show the nature of the rolling and spinning motions. The motion of a ball relative to its path may be most conveniently studied by imparting to the whole system a rotation about the axes of the bearing sufficient to bring the center, c, of the ball to rest. The ball paths, C and D, will then be rotating in opposite directions. If the bearing is of a two-point contact type, the pressures, f_1 and f_2, on the balls (Fig. 2) must be equal and opposite, and therefore the points of contact, a and b, of the ball with its paths must be at the ends of a diameter. From a let a tangent, av_2, be drawn to the common surfaces in contact; then if pure rolling motion exists at a, the parts of the ball and of the ball path which actually roll on each other may be considered to be small portions of a pair of cones having a common vertex, v_2; the ball, B, must therefore be rotating about the axis, cv_2. Consider the motion of the ball on the outer path, D; a similar argument will show that if the relative motion at b be pure rolling, the ball must be rotating about an axis, cv_1. But the ball cannot be rotating at the same instant about two different axes. The probability is that it does rotate about some axis, cv, in which case slight spinning motions exist at a and b in addition to the rolling motion.

Two, Three, and Four-Point Contacts.—In Fig. 1 each ball has two points of contact with its paths. Fig. 3 shows a three-point, Fig. 4 a four-point contact bearing. The three-point contact bearing has a considerably greater amount of spinning friction. The instantaneous axis of relative motion must itself pass through the two points of contact of the outer path. But if only a pure rolling motion existed at each of these points, the instantaneous axis must lie in the

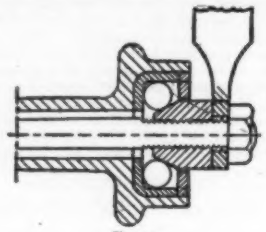


FIG. 3.

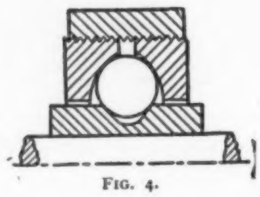


FIG. 4.

surface of the ball path. There must, therefore, be a considerable spinning motion at each point, so as to bring the resultant motion to take place round the afore-mentioned axis.

One or two important points of comparison may be made between the two types of bearing. Fig. 5 shows three sections of a two-point bearing. The first section shows the line of contact making an angle of 45 degrees with the axis. The second section shows the inner path of exactly the same dimensions as in the first case, the outer path of exactly the same outline, but with its diameter a little less; the effect is to bring the line of contact nearly perpendicular to the axis. The third section shows the outer ball path a little larger in diameter than in the first; the effect is to bring the line of contact more nearly parallel to the axis. In the

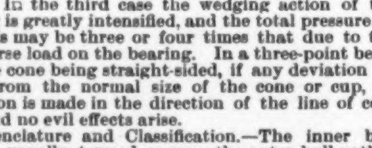


FIG. 5.

second case there is little or no resistance to end thrust, and the balls may actually jamb between the ball paths, developing pressure sufficient to break one or other. In the third case the wedging action of the bearing is greatly intensified, and the total pressure on the balls may be three or four times that due to the transverse load on the bearing. In a three-point bearing, the cone being straight-sided, if any deviation be made from the normal size of the cone or cup, no alteration is made in the direction of the line of contact, and no evil effects arise.

Nomenclature and Classification.—The inner ball path is usually termed a cone, the outer ball path a cup or a disk. The inner portion of the bearing I shall call the spindle, and the outer portion the barrel. In wheel hubs, the barrel rotates, in pedals and crank brackets, the spindle rotates. From Fig. 1 it is easily seen that the adjustment of the bearing can be obtained by moving one of the four ball paths; we, therefore, have two types of adjustment, cone adjusting and cup-adjusting bearings.

Figs. 6 and 7 show two types of bearing; in Fig. 6

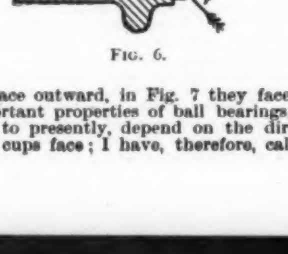


FIG. 6.

the cups face outward, in Fig. 7 they face inward. Some important properties of ball bearings, which I shall refer to presently, depend on the direction in which the cups face; I have, therefore, called them "outward cups" and "inward cups" bearings respectively.

Pressure on Bearings.—It is well known that owing to the slope of the ball paths, there is a kind of wedg-

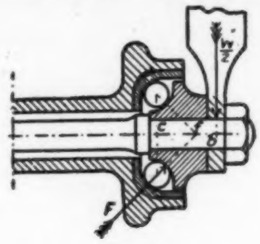
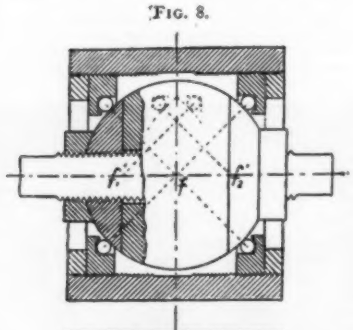


FIG. 7.

ing action in ball bearings, so that the total pressure on the balls is greater than the external load. Figs. 6 and 7 show the direction of the pressures. In a pedal or in a front wheel hub, where the load comes exactly at the middle of the length of the bearing, the pressures on the balls will be the same for outward cups and inward cups bearings, provided the slope of the paths be the same in both. The point, f, where the line of contact of the balls cuts the axis, may be called the "point of virtual support" of the bearing, and the distance between these two points for the two ball rows may be called the "virtual length" of the bearing. It will be noticed from the diagram that provided the actual distance between the ball rows be the same in both cases, the outward cups bearing has a much greater virtual length than the inward cups bearing. The model illustrates this point very well. I have here what is practically a hub with very large ball races; at present it is arranged as an inward cups bearing (Fig. 8), and the two points, f, for each row of

FIG. 8.



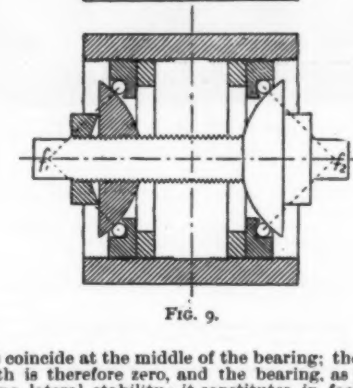


FIG. 9.

balls coincide at the middle of the bearing; the virtual length is therefore zero, and the bearing, as you see, has no lateral stability; it constitutes, in fact, a universal joint. Its lateral stability is increased by either moving the ball races closer together or further apart.

The central distance piece will now be removed so as to bring the ball races as close together as the model permits. The pressure lines from the two rows of balls now cross, as indicated by the dotted lines (Fig. 8); and, as you see, the bearing has now a fair amount of lateral stability. The model may now be arranged as an outward cups bearing, and keeping the same distance between the ball races, as in the first experiment, the virtual length is greatly increased ($f_1 f_2$, Fig. 9); and, as you see, the bearing is very stable laterally.

Pressure on Crank Axle Bearings.—In a bearing where the pressure is applied outside the ball races, as in the case of a crank axle, the actual pressure on the rows of balls is very much less with outward cups than with inward cups. At present, it is almost the universal practice of English makers to have the crank bracket bearing with inward cups, but many American makers, and one or two English makers (Messrs. Rudge-Whitworth, Limited, and Messrs. Ryley, Ward, and Bradfield, makers of the "Tribune" cycle) make outward cups crank bracket bearings. It is instructive to look at the diagram illustrating the

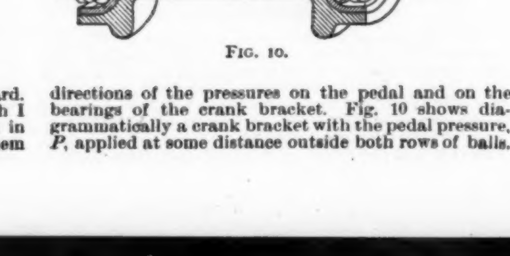


FIG. 10.

directions of the pressures on the pedal and on the bearings of the crank bracket. Fig. 10 shows diagrammatically a crank bracket with the pedal pressure, P, applied at some distance outside both rows of balls.

* Lecture delivered before the London Society of Arts and published in the Journal of the Society.

The pressure on the near row of balls will be confined to two or three balls near the bottom, and the direction of the resultant, F_1, will practically coincide with the line of contact of the lowest ball. Now the axle is acted on by three forces, the pedal pressure and the resultant pressures, F_1 and F_2, of the two rows of balls. Hence, by the well-known law quoted in all text-books of mechanics, these three forces must intersect at one point, and the direction of the pressure, F_2, on the further row of balls is determined. F_2 passes through the point of intersection of F_1 and P, and through the virtual support, f_2. Fig. 11 shows the force dia-

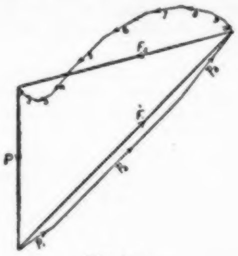


FIG. 11.

gram drawn out, from which it will be seen that the pressure on each row of balls is very much greater than the pedal pressure, P. The diagram is perfectly general, and can be applied to any case. I have here a wooden model, of about twice usual size, of an axle with a pair of loose cones which can be turned with their vertices outward or inward, and which illustrate experimentally the same facts. The cups are also of wood and are not mixed in any way, but they are actually supported by a pair of pins projecting from the outer surface, the center line of the pin passing through the point of virtual support. One end of a spiral spring is attached to these pins and the other to an adjustable screw bolt passing through a bracket fixed to the base of the apparatus. The only forces acting on each cup are the pressures of the balls and the pull of the spring; the latter, which is indicated at once in magnitude and direction, is therefore equal and opposite to the resultant pressure of the balls. The pressure corresponding to that exerted on the pedal is applied by a third spiral spring. On tightening up one or other of the springs, the axle with its bearings adjusts itself into its position of equilibrium. It has been tacitly assumed that the pressure on the ball races is at right angles to the axle; but if it be attempted to bring this spring supporting the near cup any nearer the vertical, the cup at once tilts and does not remain concentric with the cone. The spring may be brought nearer the horizontal, causing the other spring also to come nearer the horizontal. In fact, the direction of the resultant pressure, F_1, must be a line passing through the virtual support, f_1, and passing inside the ball circle. The model is so arranged that the actual support can be moved to the same plane as the ball circles; in this case the cup tilts in the opposite direction.

The model is at present arranged as an inward cups bearings, and for a pedal pressure of 15 pounds the pressures on the ball rows are 51 pounds and 60 pounds respectively. Mr. Ackermann will change it to an outwards cup (cone adjusting) type, and keeping the same distance between the rows of balls, we find that for a pedal pressure of 15 pounds the pressures on the ball rows are 26 pounds and 35 pounds respectively.

The wall diagram or the model also shows clearly the effect of bringing the applied pressure nearer the ball races. In the case of the pressure due to the pull of the chain, the pressure, P, may be applied very near the ball race. If it be applied through the point of virtual support, f_1, the pressure on the further row of balls is not zero, as many people imagine, but is actually an end thrust in the direction of the axle. On applying a pedal pressure of 15 pounds, passing through the virtual supports, I find the pressures on the bearings 15 pounds and 27 pounds respectively.

In a one-row ball bearing, as in the Quadrant pedal, the lateral stability depends essentially on the geometric conditions I have been explaining. If the pressures were at right angles to the axis, the one-row bearing could have no lateral stability.

I have designed a ball bearing with the object of reducing the frictional resistances to a minimum. The main rows of balls run between concentric cylindrical paths, and have therefore no power of resisting end thrust. This is taken up by a third row of balls, or by a row at each end, making in all four rows of balls. The spinning friction in this bearing is therefore reduced to a minimum, and is due only to the end thrust, not to pressure on the axle or hub. If the resistance of a ball bearing were about 100 times what it actually is at present, this type of bearing might be of practical value. But as the frictional resistance of any decently made ball bearing is very small, the additional complexity probably outweighs any advantage.

(To be continued.)

Bicycle Factory in Java.—There has lately been established in the city of Samarang a bicycle factory which is having considerable local success, though not many of the wheels have as yet been seen in Batavia, says Sidney B. Everett, consul at Batavia.

The name of the concern is the Rijwiel-Fabriek Insulinde, and the capital is about $10,000. The method is to import the different parts of the machines from Germany and put them together here. Besides the manager and bookkeeper, who are Dutchmen, there are two German skilled workmen, who have under them a number of natives. The machine is a good one and sells for about $70. The racers weigh about 18 to 20 pounds and the roadsters about 25 to 35 pounds.

They have succeeded in getting the best part of the bicycle trade of Samarang and the immediate neighborhood, and are now advertising for agents to represent them in the different parts of Netherlands India.

It seems to me, however, that this ought not to alarm our manufacturers, as they ought to be able to sell a good medium grade wheel here for less than $70 and make a reasonable profit. As I pointed out in my last bicycle report (Consular Reports No. 219, December, 1898), the best thing our bicycle men could do is to send out a good medium grade wheel—one which will sell for a little less than $70. There is only a very limited demand for the highest grades of wheels, as people here are not willing to pay the prices.

Several makes of American wheels are here, and they are selling fairly well; but the trouble is that their agents are, in almost every case, interested in pushing some English or German wheel. European manufacturers usually grant easier terms to their agents and customers here in regard to payments and commissions.

Our merchants and business men are too fond of adopting a "spot-cash" attitude; if they wish to enter the East Indian trade, they will have to give up these methods or the Europeans will continue to retain the bulk of the business.

Speaking of bicycles leads me to say that this is the very finest kind of a country for automobiles, as the roads are good, and owing to the bad climate, the wear and tear on horseflesh is very great. At present, there are only two in the island—of what make I do not know. I am convinced that it would pay to introduce them. An active and capable agent should be sent out who could spend some time in giving exhibitions and showing people what a saving of horseflesh there would be. Power is cheap here, as water is abundant and fuel and labor reasonable in price. The attempt should be made, and I shall be very glad to answer any inquiries, in this regard, which our manufacturers may desire to make.

REMINISCENCES OF BUNSEN AND THE HEIDELBERG LABORATORY, 1863-1865.*

I FIRST met Bunsen in the lovely, retired valley of Engelberg, Switzerland, during the summer of 1863. I had spent the preceding twelve months in Paris, working in Dumas' laboratory at the Sorbonne, and in the École de Médecine under Wurtz, and was expecting to continue my studies in Heidelberg. Learning by accident that Bunsen was at an adjoining Gasthaus I called on him and told him of my plans. He received me graciously, and immediately won my heart by his affability, by the charming smile that lit up his large features, and by his unselfish interest in my personal affairs. Being myself quite ignorant of the German language we conversed in French, and he gave me useful hints as to the opening of the University laboratory.

My first semester at Heidelberg was devoted almost exclusively to laboratory work, but I attended Bunsen's lectures on general chemistry every morning at nine o'clock in the adjoining auditorium. Bunsen's habit of saying one word when he meant to use another was at first puzzling, particularly as I was very weak in German, but when he exhibited the violet vapor of iodine and called it chlorine, my previous knowledge of chemistry assisted comprehension. After every lecture Bunsen rarely missed spending several hours in the laboratory, going from student to student with inquiries, suggestions, and useful hints. Desirous of securing my share of this personal contact, I soon found the best way to induce the Hofrath to linger was to have a supply of clean test tubes and beakers on an orderly desk with a query or two requiring experimental answers. Any suggestion as to the use of the spectroscope in connection with a substance under examination was sure to interest the professor, as that famous instrument was a comparatively new adjunct to chemical work, being then about four years old.

When in the laboratory Bunsen habitually carried between his lips a short, unlighted cigar, and he often stopped at a student's desk only long enough to light the tobacco at a "Bunsen burner;" in a few minutes the cigar was again without a spark, owing to his absent-minded neglect to pull on it. Absent-mindedness was a marked trait in Bunsen's character, and many anecdotes are told of the difficulties into which it brought him. The statement that he remained a bachelor because he forgot his wedding day is, of course, apocryphal, as is the other about his putting on a suit of garments on the top of others that he had forgotten to take off; but the following came under my personal observation. Bunsen used to dine every day at a little table reserved for him in a restaurant connected with the hotel in which I lived. One spring he fell into the habit of ordering veal cutlets and asparagus as the chief item for his meal, and without reflection or feeling that a change of diet would be agreeable, he continued to order "Kalbs-Cotelette und Spargel," daily for several weeks, until one day the kellner informed him that asparagus was no longer in season and could not be supplied. Bunsen seemed to be immensely taken a-back and to realize for the first time that he had been dining on one dish for a long period. He soon recovered himself, however, and asked the waiter for the bill of fare, from which, after careful examination, he ordered mutton chops and peas, and this was his daily diet up to the time I changed my hotel.

When the laboratory was closed for the Christmas holidays, I tried to get permission to work in the deserted rooms, but in vain, and not wishing to be idle, I worked at growing crystals, improvising a desk out of a hotel washstand, and a heater out of the huge porcelain stove.

Some time after I showed to Bunsen a single crystal of copper calcium acetate, about three inches long, with perfectly regular facets, and of which I was quite proud. He looked at it rather solemnly, as I thought, and enunciated the single word "ausgezeichnet!" This was not in my limited vocabulary, and whether a commendation or a disapproval I could not divine. I puzzled over the word all day, and on returning home the dictionary explained its meaning to my great satisfaction.

As my knowledge of German increased, I attended the lectures of Kirchhoff and of Kopp, but was never able to enjoy the latter's interminable sentences and involved style.

Bunsen's assistants in the laboratory at the time of my sojourn were Dr. Bender and Dr. Rose. The latter had the reputation among the students of giving more accurate instruction in mineral analysis than Bunsen himself. Rose is now professor in the University of Strasburg.

Bunsen's methods in mineral analysis were not wholly approved by the students. One day he stopped at my desk for a moment, and picking up a filter containing a moist precipitate he inquired: "What have you here?" Seeing with consternation a portion of my quantitative precipitate sticking to his thumb, I hastily seized a "Spritzflasche," and washed the substance off his thumb into the filter on the funnel before venturing a reply. Bunsen smiled genially and passed on to my neighbor.

Bunsen showed extraordinary callousness to heat, being able to hold in his fingers metal nearly red hot; on one occasion when stirring a glowing crucible with a very short spatula, his skin fairly sizzled, and for relief he took hold of the lobe of his ear with his smoking thumb and forefinger, explaining that the ear was the coolest part of the body.

The celebrated Dr. Fresenius, of Wiesbaden, having appropriated some discovery or method of Bunsen, without giving credit, was cordially disliked by him, and he once showed it by a significant act. A student accosted the Hofrath as he passed by and put to him some simple question in analytical chemistry; on the desk lay open a copy of Fresenius's "Anleitung," whereupon Bunsen closed the book with a deprecatory gesture, pulled out the drawer of the student's desk to its extreme limit, and thrust into it as far back as possible the objectionable volume, saying: "Nun, mein Herr, we will proceed."

Bunsen was rather sensitive to criticism; one of my American colleagues tells me of an incident illustrating this. The professor proposed to the student the joint preparation of certain cesium and rubidium salts, saying he would secure several barrels of the mineral water rich in the chlorides and would have the water boiled down to a small volume ready for the separation of the rare elements. The American felt highly pleased at the flattering proposal, and to show his interest in the matter mentioned that he had studied under Professor O. D. Allen, of New Haven, who had done work on cesium and rubidium. This was an unfortunate remark, however, for Allen had corrected Bunsen's figures for the atomic weight of Cs, and the Hofrath remembering this never again mentioned the subject to my friend.

In those days students were obliged to prepare some substances now commonly provided, and to construct some apparatus with their own hands. Every student had to etch and calibrate his own eudiometer, and some of them wasted much time over the hydrofluoric acid process before getting good results. I remember, too, purifying potassium hydroxid by solution in alcohol (an extra charge), and evaporation in a large silver basin loaned by an assistant. One green, Russian student bought at Desaga's potassium cyanid instead of the hydroxid and was vainly trying to dissolve it, walking about the laboratory shaking the bottle for hours; when Bunsen noted its singular appearance, he caused the operation to be suspended, and on ascertaining the nature of the substance, cautioned the student against it.

Speaking of Russians reminds me of an amusing occurrence; one of them was instructed to precipitate a substance "mit überschüssigem Kali," and not finding any bottle labeled "überschüssiges Kali," he inquired for it from a neighbor, who mischievously sent him to Dr. Bender, telling him the article was kept under lock and key with other costly substances, such as silver nitrate and platinum chlorid. The astonished assistant explained to the Russian that an excess of potash did not require a special bottle; the student was nicknamed "Überschüssiges Kali" for the rest of the semester.

Many nationalities were represented in Heidelberg laboratory; besides Russians there were Bessarabians, Hollanders, Bohemians, Germans from North and from South, Austrians, one Chilean, one Englishman (the late Dr. Walter Flight), one Scotchman, one Irishman and several Americans, fifty-nine students in all, of which fifty-eight were incessantly smoking; the fumes of tobacco mingled with vapors of H_2S, SO_2, HNO_3, and NH_3, making an atmosphere so thick that I regret not having cut off a slice as a souvenir.

The students, from time immemorial, had a voluntary organization to maintain order in the laboratory; they elected at the beginning of each semester an officer known as "Polizei-Diener," who was authorized to impose small fines for petty offenses, the money thus secured being devoted at the end of the term to the purchase of books for the small library placed on shelves in the balance-room. This custom I understand still obtains. At the opening of my third term I was elected "Polizei," and duly instructed in my duties; being watchful and courageous I collected more money during my term of office than had been added to the library fund for many years. The misdemeanors for which fines were imposed were leaving an unused gas-burner lighted, failure to resort to the "Stink-Zimmer" when noxious gases were generated, failure to replace bottles or apparatus used in common, and leaving a balance door open or weights on the pans, which latter was accounted a very heinous offense; the fines ranged from six kreutzers (Baden) to half a gulden. My official life was marked by two events that greatly excited and amused the whole laboratory; one of the events was regarded as an exhibition of unparalleled audacity, of which only an American was capable—I fined Hofrath Bunsen! The Professor, after lighting his cigar at the flame of a Bunsen burner, left the gas burning and went out of the room; according to custom, and to the consternation of the students, I chalked on the desk that Bunsen had used, the words "6 Kr." over my initials, a notice that could not be erased until the fine was paid. Next day when Bunsen approached the desk, he glanced at the inscription, smiled broadly, and to the amusement of the crowd of students that had gathered to see the result of my daring, opened his purse and handed me the six kreutzers with a pleasant commendation of the fidelity of the 'Polizei.'

The other event concerned a very close-fisted American whose numerous fines I was unable to collect; when they reached the enormous sum of one and a half gulden (about 60 cents), I consulted some of the older German students, stating the facts and asking for advice. They declared they had never heard of such a case, and they authorized me to confiscate some chem-

* Dr. H. C. Bolton in Science.

ical apparatus belonging to the American and to sell it at auction. I secured a fine beaker-glass, the outside one of a large nest, and after due notice, amid the shouts of the fifty-nine students gathered in the lecture room the beaker was sold at auction; the competition to secure it was so keen that it brought a very high price, the sum covering the fine plus the value of the glass. The excess had to be paid back to the lucky American, so that the fine did not come out of his pockets, after all.

Several times in the course of his life Bunsen was injured by explosions; he was popularly believed to be minus one eye, one ear, and one lung, and there is some foundation for this, for he lost an eye when working at cacodyle, and he was slightly deaf. It was related of him that on one occasion a violent explosion threw him to the ground and made him unconscious; on coming to, his first words were: "Has any of the substance been saved?"

In 1865, Bunsen was invited to fill a chair in the University of Berlin, and after due consideration he declined the flattering call, to the delight of all educational Heidelberg. In his honor the students organized a torchlight parade; the chemists marched in a body, and carried away by enthusiasm I imprudently joined them, carrying a torch with the crowd. The procession paraded the principal streets and then assembled in the open square before the Aula, or central hall of the University; there the students, singing the Studenten Lieder, formed a ring, gradually closing in toward the center, making the ring smaller, until at a given signal they threw their half-burned torches into the very center and the pile blazed on high, making an impressive ceremonial. I have said I imprudently joined because I failed to anticipate the disagreeable consequences; the smoke of a half-a-thousand torches, the dripping grease, and the dust of the streets, combined with the moist exudation of my membraneous integument to form a black deposit that would have honored a stoker, besides ruining a suit of clothes.

During my residence in Heidelberg a lamentable and terrible affair took place that threw a profound gloom over the University and the entire town. Two German students having quarreled decided the earth was not large enough for both of them to live in, and resorted to the diabolical practice called the "American duel."

In a darkened room the two young men drew lots, having sworn that he who drew the black ball would commit suicide. The unhappy loser went to his room and discharged a bullet into his breast, but missed his heart and lingered for several days on his death bed; his parents were summoned by telegraph and besought him on their knees to disclose the name of his antagonist, but he steadfastly refused and died with the secret in his breast. The students not only excused his conduct but praised his courage, and when his remains were taken to the railway station to be transported to a distant city, they accompanied the funeral cortége with torches and music. The students claimed he was not a suicide, for he was killed in an honorable duel, and they maintained that his opponent was not accessory to his death because he shot himself. I had many arguments with them, and never could convince them of their extraordinary tergiversation.

The whole system of dueling at Heidelberg is an interesting feature of student life that I had good opportunities of observing without taking part, but as Kipling says, "That is another story."

The intimacy of Bunsen and Kopp is well known. I have often seen them walk through the narrow streets hand-in-hand like affectionate school girls, Bunsen's large frame and Kopp's diminutive stature making a strong contrast.

Bunsen had great talents and personal attractions, yet he did not succeed in fostering original work on the part of those who studied with him. I think this is partly due to the fact that they were chiefly beginners, and when they had acquired the rudiments of general chemistry, they took to the fertile fields of organic chemistry under other masters. Yet his pupils include some men of high rank in the profession, Lothar Meyer, Sir Henry Roscoe, Beilstein, Lieben and Carius.

I last saw Geheimerath Bunsen during a brief visit to Heidelberg in 1891; he had retired from active duty and complained of the infirmities of advancing years, being subject to rheumatism, but he exhibited the same cordial manner, the charming smile, and a willingness to listen to the accounts of Americans who had pursued their studies in the Heidelberg Laboratory. Bunsen died after a lingering illness, August 16, 1899, at the great age of eighty-eight.

Among the Americans contemporary with me may be named:

Eli W. Blake, afterward professor of physics at Brown University, deceased.

Orren W. Root, afterward professor of chemistry at Hamilton College, deceased.

Charles Wolf, of Cincinnati, deceased.

George M. Miller, of New York.

Harry McBurney, of Boston.

Lyman Nichols, of Boston.

Arnold Hague, of the United States Geological Survey.

Frank Slingluff, of Baltimore.

There was no club or association among the Americans such as exists in Göttingen, and a full list of Americans who studied under Bunsen could only be made from the official register of the University.

Of the charm of residence in the picturesque little city on the Neckar, with its magnificent ruined castle, its attractive forest-covered hills threaded by enticing paths, its historical associations, and its excellent beer, there can be but one opinion; but in winter we often felt the truth of the old couplet:

Heidelberg ist eine schöne Stadt
Wenn es ausgeregnet hat!

A lady of Orange, N. J., is teaching the art of raising mushrooms. She is probably the first to give instructions in the art. She discovered that it was an art, and a difficult one to learn, and she was in turn taught by a professional mushroom raiser, and then she started to work on her own responsibility. She thoroughly mastered the literature of the subject and also the practical side of it, and she now has more customers for mushrooms than she can supply. Many ladies have taken up the culture of mushrooms, and have been very glad to engage the services of the new mushroom teacher.

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TABLE OF CONTENTS.